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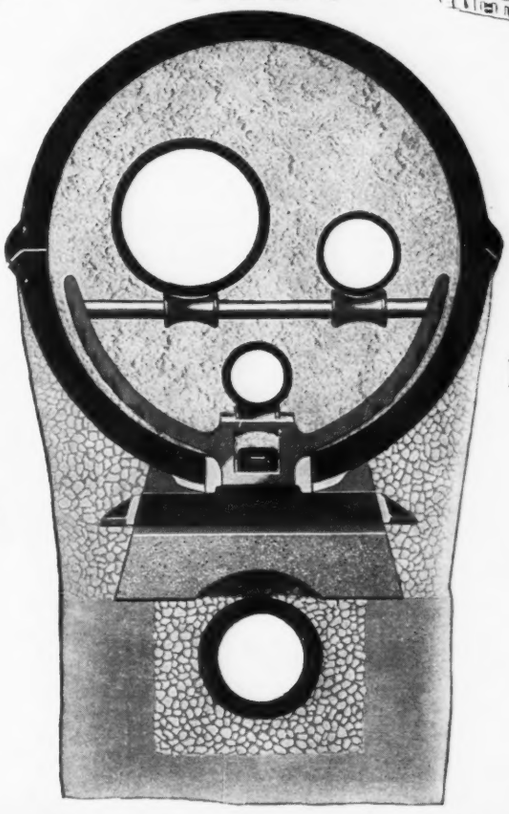

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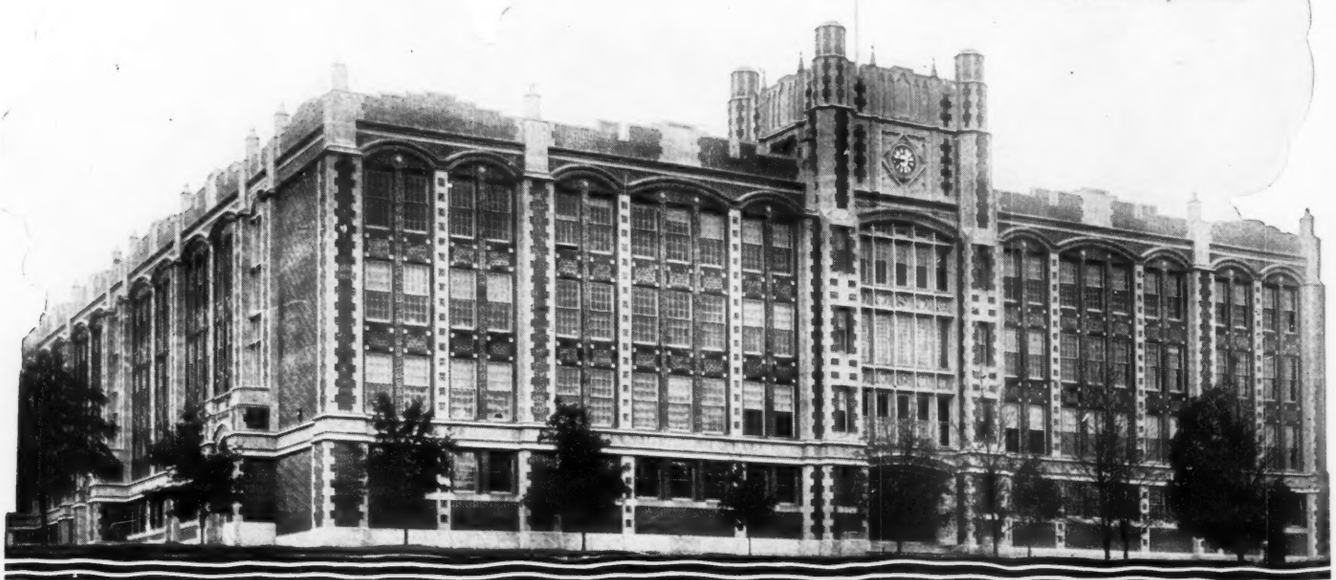

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FEBRUARY, 1923

Is There Any Saving in Vacuum Heating?

Affirmative Replies to Inquirer's Query as to the Advantage of Vacuum Over Gravity Steam Design

1.—Comparison of "Open" and "Closed" Systems

BY A. L. BROWNE,

Illinois Engineering Company.

THE article by Inquirer in the December issue of THE HEATING AND VENTILATING MAGAZINE, raising the question as to whether there are advantages and economy under vacuum-operating conditions in a gravity heating system, as opposed to a system without vacuum operating features, should be of considerable interest, as it indicates a unique combination of half-facts which, in fairness to Inquirer, may be said to exist all too generally.

The writer is undoubtedly the "heating system man" referred to by Inquirer and as such may say that the statement attributed to the writer that an owner could save 20% in fuel consumption in any atmospheric vapor-type system by utilizing his "vacuum maker" is not wholly correct. What the writer said, relating to economy, was in connection with an 18-hr. test conducted in an apartment house in Newark, having about 200 radiators, totalling approximately 5,000 sq. ft. of radiation (water type) with a 5,500 sq. ft. steel boiler. The vapor system was operated one day "open" and one day "closed" alternately throughout the eighteen days of the test. This was accomplished by connecting a radiator supply valve at the termination of the dry return, between it and the " vacuum retaining trap," referred to by Inquirer as a "vacuum maker." This valve was opened at 6:00 P. M. and closed the next night at the same hour.

This, then, permitted a comparison in the operation of the system as "open," without vacuum conditions, and "closed," with vacuum conditions. The accompanying reproductions of the original charts from this test indicate the typical pressure conditions when "open" and "closed." It will be seen that the pressures above atmosphere were, in both instances, only slight.

The system equipment consisted of modulating or quick-opening packless-type radiator supply valves, thermostatic radiator traps, automatic condensation return trap or "alternating receiver," vacuum-retaining trap and damper regulator.

A recording thermometer was placed in an empty two-room corner apartment on the top floor. Pressures were maintained as indicated on the accompanying charts. Hourly outside temperatures were obtained from the weather bureau. A careful record of the coal consumed daily was made.

In comparing the records of nine days each it was found that under "open"-system conditions, 20½% more fuel was consumed than under the "closed" or pressure and vacuum-operating conditions. Also the average hourly temperature difference, inside and outside, was a degree and a fraction in favor of the latter.

If the records taken may be relied upon as accurate and are sufficient in their scope, they would them, at least, indicate operating economy.

PREVIOUS TESTS

Beyond copies of one or two tests made by Professors Carpenter and Kinealy for the Paul Company, a number of years ago, the writer has been unable to obtain any data relating to the subject. These tests relate to low-pressure steam generation. At atmospheric steam pressure (212° F.) as compared with 5 lbs. gauge (227° F.) they show economy for the lower pressure and temperature to the extent of approximately 10%.

CONDITIONS AFFECTING ECONOMY

To forecast a definite degree of relative economy would, in the writer's mind, be extremely difficult as this would depend on a number of varying factors. The

type of boiler, length of gas travel, relationship of direct and indirect fire surface, relation of size of boiler to radiation load, degree of vacuum obtained and average period of time retained, would all be vital factors in the determination of the specific degree of relative economy.

Something definite along this line may be accomplished by making tests in numerous buildings where the type of boiler, size, radiation connected and degree of vacuum and other varying factors would be sufficiently divergent to give a fair average index of what degree of vacuum may be anticipated. The writer believes that such tests, where a given plant is operated both ways for a reasonable period, would provide far more trustworthy facts than the frequently-cited cases of a building on one side of a street operating with a certain degree of economy compared with a corresponding building on the other side of the street.

The Query

A heating system man recently made the flat statement that with his specialties installed the owner could save 20% of the coal required by any similar or good-working vapor heating plant. This contention is based upon the assertion that his "vacuum-maker" is the only thing of its kind on the market and therefore no one else could duplicate the results in a gravity job using thermostatic traps with graduated valves on radiators.

Even if no one else does make such a vacuum device, I am not convinced that a vacuum maintained on a gravity heating plant gives any saving over a straight vapor job with thermostatic traps and a return-to-boiler trap at the boiler. I am willing to be shown how the saving is accounted for, because it would be a very worth while proposition and a public benefit. Will not some of the engineers and heating system men who are readers of your journal, as well as experienced contractors who can throw some light on this subject, give their views on this important problem?

For general information I might state that one of the younger men I know, who is pretty handy at figuring, leads me to believe that this claim of a saving by means of a vacuum is merely one of those meaningless talking points that salesmen still insist on using. Here are the figures:

Steam at 10 in. vacuum = 192° F. = 983 B. T. U. latent heat and 1142 B. T. U. total heat. Return water = 172°.

Steam at 0 lbs. pressure = 212° = 970 B. T. U. latent heat and 1150 B. T. U. total heat. Return water = 197°.

Take 1000 sq. ft. direct radiation at 250 B. T. U. = 150,000 B. T. U. Then 250,000 ÷ 970 = 257 lbs. water condensed by steam system, and 250,000 ÷ 983 = 256 lbs. water condensed by vacuum system.

Steam system has to raise water from 197° to 212° = 15°.

Vacuum system has to raise water from 172° to 192° = 20°.

Steam system, therefore, has to supply 257 lbs. × 15 = 3855 B. T. U. and at 10,000 B. T. U. to a pound of coal = 0.3855 lbs. coal.

Vacuum system therefore has to supply 256 lbs. × 20 = 5120 B. T. U. and at 10,000 B. T. U. to a pound of coal = 0.512 lbs. coal used.

These figures favor the straight vapor job, but of course they are purely theoretical and taken on an assumed basis and at 100% efficiency all round. Even if it were possible to circulate steam and have a vacuum at the same time, and then also allowing only 15° temperature rise for the vacuum system, the coal used would still be 0.384 lbs. which, in practice, is no saving at all. Then, is the vacuum on all the time?

But will some one explain how steam can be generated and circulated under 10 in. or any other degree of vacuum, when it is generally understood that steam breaks a vacuum, instead of making one. Also, do the above figures come anywhere near being right?

INQUIRER.

ANALYSIS OF FIGURES SUBMITTED

The figures submitted by Inquirer are wrong fundamentally insofar as proving economy are concerned, as they fail to take into consideration the crux of the whole subject, the boiler. In detail a number of errors are to be noted. For instance, 1000 sq. ft. of radiation would not provide 250,000 B.T.U. per hour at 10 in. of vacuum. Also the assumed return water temperature drop should be the same in both instances, instead of 20° for one and 15° for the other. Furthermore, these values should have been included in the total heat given from the radiation. Inasmuch as this is simply adding and deducting the same value, it has been eliminated by the writer in the following calculations.

CALCULATIONS FOR THE TWO SYSTEMS

In order to favor the (above atmospheric pressure) vapor system, we will allow an assumed minimum boiler working pressure of slightly over 1/4 lb. gauge pressure, in comparison with steam below atmospheric pressure to the extent stated, 10 in. of vacuum. From "Properties of Saturated Steam" (Marks and Davis) absolute pressure of 14.99 lbs. per square inch, or roughly 7/4 lb. gauge, gives 213° F. steam temperature, and latent heat of 969 B.T.U. on one hand. On the other, absolute pressure of 9.74 lbs. per square inch, or approximately 10 in. of vacuum, gives 192° F. steam temperature, with latent heat of 982 B.T.U.

Assuming the radiation to be 3-col. 26-in. high, this will have a value of 1.65 B.T.U. per square foot per degree difference, based upon 150° difference, allowing 0.2% per degree above or below standard (150°) range, according to Harding and Willard and Charles A. Fuller. The room temperature assumed is 70°. Pressure drop not considered. Therefore:

(A) { (213 — 70) x (1.65—[0.002 x 7 x 1.65]) x 1000 } ÷ 969 = 240 lbs.

(V) { (192 — 70) x (1.65—[0.002 x 28 x 1.65]) x 1000 } ÷ 982 = 194 lbs.

While 240 lbs. of steam per hour (A) would heat the building to 70° F. at a few degrees above zero, 194 lbs. of steam per hour (V) would heat the building at 70° most of the time throughout the winter. It is to be noted that it is assumed that the circulation would be thorough and consequently the heat distribution uniform throughout the building in both instances. Obviously, 194 lbs. of steam per hour at a lower temperature would require less coal than 240 lbs. of steam per hour at a higher temperature. Of course, it is to be understood that in approximately zero weather 240 lbs. of steam per hour would be required in both instances.

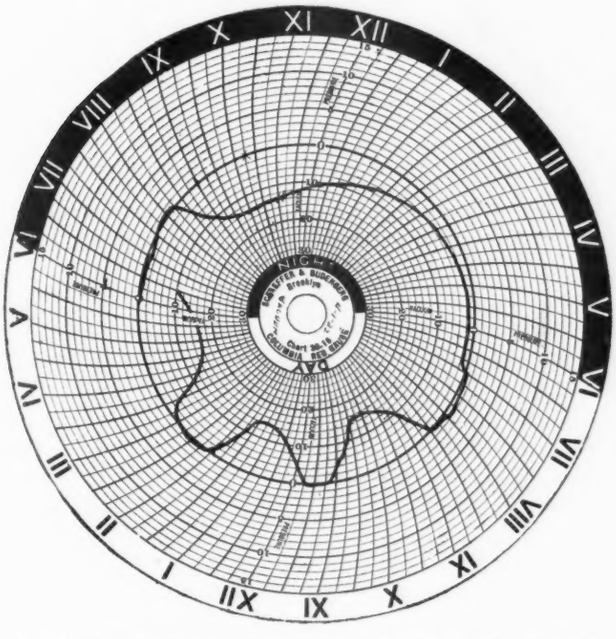
From the above one can deduce that (excepting continual radiator supply valve manipulation) most of the time more pounds of steam would be evaporated than outside weather conditions require in the average system of steam or vapor heating.

ANALYSIS OF THE CHARTS

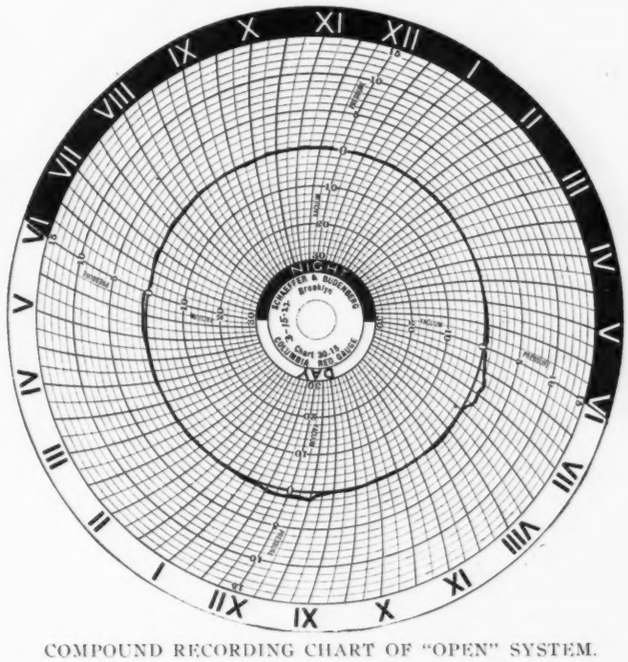
Referring to the compound recording chart of the "closed" system, it will be seen that the period (at and above atmospheric pressure) amounts to only three hours and forty-five minutes during 24 hours, the average outside temperature being 38° F. on that day.

Referring to the "open" system chart, it will be seen that the period (at and above atmospheric pressure) amounts to seven hours during 24 hours, the average outside temperature being 48° F. on that day.

Referring again to the "closed" system chart, it is obvious that on the down curve of the vacuum, the radiation is essentially hot at a corresponding temperature indicated by the degree of vacuum obtained. Where the curve again rises toward the atmospheric line, it either represents air infiltration with the radiators consequently cooling, or a rise in boiler pressure with the radiator remaining essentially hot. Referring now to the "open" chart, when the pressure falls to the atmospheric line, due to a retarded rate of combustion, the radiation becomes essentially cool within a relatively short period.



COMPOUND RECORDING CHART OF "CLOSED" SYSTEM.



COMPOUND RECORDING CHART OF "OPEN" SYSTEM.

FACTOR OF BOILER EFFICIENCY

Viewing Inquirer's calculation from another angle, if he required 250,000 B.T.U. per hour as a constant hourly total, the fuel consumption would be approximately the same, whether at 10 in. of vacuum, 10 lbs. gauge pressure, or at any other pressure. It would, however, be necessary in one instance to increase the radiation and, in the other, to reduce it for corresponding changing pressures. This brings us back again to the boiler and if some one can tell what their efficiencies are at various pressures below and above atmospheric pressure, then more pertinent information on the subject will be available. Boilers are rated as to capacity and efficiency at 2 lbs. gauge pressure for steam. Usually the draft pressure is not given but is expressed as draft of sufficient intensity to burn a charge of coal in five or eight hours, as the case may be. Change the draft pressure and steam pressure and you will change the rating, both as to efficiency and capacity.

VAPOR HEATING AS COMPARED WITH WATER HEATING

If a "closed" vapor system can be made to operate at low as well as at relatively high temperatures, it should prove economical for the same reason that a water heating system is universally considered economical, as compared with a steam heating system, because it works "while the steam job sleeps," namely, at less that 212° F. At the same time, a workable and dependable vapor system of this type would eliminate some of the losses of water heating from an operating standpoint.

If Inquirer will refer to "Properties of Saturated Steam," by Marks and Davis, he will find therein properties of steam at various vacuums. Or if it is realized that at Leadville, Colo., for instance, where the atmospheric pressure is 9 9/10 lbs. absolute or roughly 10 in. of vacuum, water boils at approximately 192° F. and a compound gauge set for our atmospheric pressure, would register approximately 10 in. of vacuum in the open air, it will make plain the fact that steam can be generated under a vacuum, which might be better understood if referred to as absolute pressure and corresponding boiling point.

In a heating system, generate more steam than the radiation is condensing and the steam pressure and temperature will rise, whether below or above atmospheric pressure. Conversely, condense steam faster than it is being generated and the pressure will fall, and also the temperature. If the system is a really workable "closed" system, then these conditions will obtain substantially below as well as above atmospheric pressure.

The device referred to by Inquirer, it may be added, will be described shortly in THE HEATING AND VENTILATING MAGAZINE and what can be done and has been done in a successful "closed" system with this appliance, as indicated by recording instruments, will be presented in detail.

II—Vacuum vs. Vapor or Atmospheric Heating

BY CHARLES A. FULLER

IN THE HEATING AND VENTILATING MAGAZINE for December, under the heading of Correspondence, there appeared an inquiry entitled, "Is There Any Saving in Vacuum Heating?" In the whole realm of the heating science there is probably no question which is more frequently asked and probably no question which is more frequently incorrectly answered.

Unquestionably the reason for this is the fact that few people have a very clear conception of just what is meant by the terms "vacuum system" and "vapor system." This lack of knowledge and understanding of the general subject exists not only among laymen, but also, to a surprising extent, among architects, contractors and even among engineers. There seems to be an idea that the underlying principles upon which it is based are vastly different from those of the regular steam system.

The one element which has caused various systems to be devised is the removal of air. If the air is removed from each radiator by means of devices placed directly upon each radiator, the arrangement is called a steam system. If the air, is removed through the return mains and out of one opening in the basement, the arrangement is called a vapor system. If a check valve or similar device is placed on the vent opening to prevent the return of air into the system, it is called a vacuum system. The term "vacuum system" is also applied to the arrangement where a vacuum pump is attached to the return main and a vacuum is produced mechanically in the return mains to facilitate in the removal of air and condensation. This system is generally used in connection with high-pressure plants where exhaust steam from engines is utilized for heating purposes and would therefore, not be considered in the present discussion.

THEORETICAL EFFICIENCIES OF THE VARIOUS SYSTEMS

In order to properly compare the theoretical efficencies of the various systems the waste or loss must first be considered. The only heat loss which could properly be charged against a piping system would be the loss due to radiation from the basement mains. The losses in the boiler plant must rightfully be charged against the boiler and not against the system. It would, therefore, be impossible to determine the comparative efficiencies of a straight steam system or vapor system as against a vacuum system by any thermodynamic calculation involving the difference in temperature between the supply and return mains at the boiler and the latent heat in each case.

If the water of condensation from one system returns to the boiler at a lower temperature than in another, this simply means that the water is retained in the radiator slightly longer in the first case and a little more heat is given up to the rooms to be heated per pound of steam condensed. On the other hand, the boiler would have to add more heat units per pound of steam evaporated. But as more heat units are obtained from each pound of steam condensed in the former case, less steam would be necessary to produce the required number of heat units within the room and the theoretical efficiency is the same in both cases. This is on the assumption that the radiation losses from the basement mains would be the same in each case.

All theoretical calculations must be based on an equal number of B.T.U. transmitted to the space to be heated, without regard to the actual amount of radiating surface. If we are comparing two systems in which the steam temperature of one is lower than the other, more radiating surface would be required with the lower temperature, in order to transmit the same number of heat units.

A TYPICAL EXAMPLE

To illustrate, let us take a concrete example, assuming a space which requires 50,000 B.T.U. per hour to maintain the required temperature. We will also take the same conditions as were used in the article referred to above, namely, one system operating under a vacuum of 10 in. and, second, a system operating at atmospheric pressure. In the article in question a temperature difference was assumed between the steam in the supply main and the returned condensation of 20° for the vacuum system, and 15° in the atmospheric system. There is no particular reason why there should be this variation in the two conditions, except as pointed out above, that the water of condensation is held in the radiator slightly longer in one case than in the other, and this water is cooled to a lower temperature before passing into the return. As a matter of fact, everything else being equal, there would probably be a little less difference in temperature in the system operating under a vacuum.

The condensation in the return mains would be at a lower temperature and the cooling effect of this condensation in its passage back to the boiler, due to loss in radiation, would be slightly less. However, as we are making only theoretical comparisons for the present, this item must be neglected.

The temperature of steam under 10 in. of vacuum is 192° F. With a room temperature, in which the radiating surface is located, of 70° F., the difference in temperature between the steam and the room is 122°. Let the radiating surface in the room consist of 2-col. 38-in. radiators, the heat transmission of which is approximately 250 B.T.U. per square foot per hour under standard conditions, that is, 150° difference between steam temperature and room temperature. The transmission per degree difference per hour would be 250/150 = 1.67 B.T.U. This factor decreases about 2% for each 10° decrease in the temperature difference from standard or, under the above conditions 2.8%. The transmission factor would, therefore, be 1.623 and the total transmission per square foot per hour would be 122 x 1.623 = 198 B.T.U.

In order to transmit 50,000 B.T.U. per hour, therefore, 50,000/198 = 255 sq. ft. of radiating surface would be required. The amount of heat given up by each pound of steam would be the latent heat at 10 in. of vacuum, plus the heat removed from the water of con-

densation before it leaves the radiator. This latter is the difference in temperature between the steam and the water, or, in the assumed conditions, 20 B. T. U. The total heat per pound is therefore 983 + 20 = 1003 B.T.U. and the total steam required is 50000/1003 = 49.8 lbs. per hour.

HOW THE SECOND CASE WORKS OUT

Taking the second case, with steam at atmospheric pressure, the total heat required would be the same as before, or 50,000 B.T.U. per hour and, with a heat transmission of 250 B.T.U. per square foot per hour, the radiating surface required would be 50,000/250 = 200 sq. ft., instead of 255 sq. ft., as in the first case. Assuming the same difference in temperature in the return main as was taken in the article referred to, or 15°, the total heat obtained per pound of steam condensed would be 970 + 15 = 985 B.T.U. The total steam required, therefore, would be 50000/985 = 50.8 lbs. per hour, as against 49.8 lbs. in the former case.

The amount of heat transmitted by the boiler to the steam must, of course, be the same in each case, or 50,000 B.T.U. per hour and consequently the amount of coal would be the same, with equal boiler efficiencies and equal radiation losses. There would be a slightly lower loss in radiation from mains and boiler with the vacuum system, due to the lower temperature, but this amount would be so small that it could easily be neglected.

ECONOMY DUE TO PRACTICAL OPERATION AND CONTROL

Thus it can readily be seen that, from a theoretical standpoint, there is no efficiency gained in operating a system under a vacuum, over atmospheric operation. All of the foregoing calculations, however, do not prove that there is no efficiency to be gained in the former method because there is the question of practical operation and control which are of considerably more importance, from an efficiency standpoint, than the theoretical considerations.

Anyone who has had experience with the operation of a steam plant has encountered the difficulty of steam distribution in moderate weather when the boiler plant is operating at about one-half of its rated capacity or when it is not generating sufficient steam to fill the entire system. This is the condition which prevails in the average residence plant at least 75% of the time. The fire is banked in the morning and kept checked until late in the afternoon or perhaps until the evening, depending on weather conditions.

During this period and particularly the first part of the banked period, before the fire has had an opportunity to burn through, the boiler will not be producing enough steam to fill even half of the system. The result is that the radiators most favorably located and generally nearest to the boiler will receive and condense all of this steam, while the ones more distant will remain cold until the drafts are opened and the rate of steam production increased. The more favored rooms are naturally overheated while the ones supplied by the radiators farthest from the boiler are underheated.

Now let it be assumed that a vacuum of 10 in. is maintained throughout the period while the fire is banked, and compare the conditions. Referring to the steam tables, it will be noted that the volume of 1 lb. of steam at atmospheric pressure is 26.8 cu. ft. and, at 10 in. of vacuum, the volume is 39.2 cu. ft., or approximately 50% more. If the boiler were operating under identically the same conditions in the latter case and producing the same number of heat units or approximately the same quantity of steam, this steam would fill 50% more of the radiators than before. Furthermore, the radiators nearest the boiler, which would be completely filled with steam in both cases, would be at a lower temperature and consequently produce less overheating in moderate weather.

In other words, there would be a more uniform distribution of the heat with the vacuum system. This would reflect in coal saving by less frequent opening of the drafts in order to maintain the rooms furthest from the boiler at the required temperature.

Just how much of a saving this would produce would, of course, be impossible to determine theoretically as there would be so many things to take into consideration, but there would unquestionably be quite a considerable gain in economy in the average residence or apartment building.

With the use of fractional supply valves in connection with a vapor system, it would be possible to produce the same distribution of steam, or even better, than with the vacuum, by restricting the flow to the nearest radiator and thus sending the surplus to the remote radiators. Experience has demonstrated, however, that very little use is made of the modulating feature, even when the advantage is given to the occupant.

ATMOSPHERIC PRESSURE NOT A FACTOR IN INTERIOR OF SYSTEM

Some doubt is expressed in the article referred to as to whether or not steam would circulate under a vacuum as steam is "supposed to break a vacuum." The best method in which to form a true conception of just what goes on in a steam heating system is to consider the interior of this system only on a basis of absolute pressure and to remember that there is no definite point, such as at atmospheric pressure, when the laws governing the relations of pressure and temperature change. In other words, as far as the interior of a system is concerned, there is not necessarily any such point as atmospheric pressure.

Let us assume a heating plant in operation, every radiator completely filled with steam and a constant steam pressure of 5 lbs. per square inch being maintained. There is here, then, a condition of equilibrium established. The rate at which the steam is condensed by the radiators and piping system just equals the rate at which the steam is being produced by the boiler. If the rate at which the steam is generated at the boiler is either increased or decreased, the pressure will either rise or fall until a condition of equilibrium is again established.

If the fire is banked and the drafts checked, the rate of steam production is very materially reduced and the pressure immediately begins to fall, because the steam is being condensed more rapidly than it is being generated. With the ordinary gravity steam system, using air valves on the radiators, or with the open vapor system, as soon as the pressure falls to atmosphere, the air begins to flow back through these various openings and fills the space formed by the condensed steam. The pres-

sure within the system will remain at atmosphere, with part of the system filled with air and part with steam. Just enough of the system will be supplied with steam to condense all that is generated by the boiler in the checked condition.

Now, assume that all of the air outlets were equipped with some form of check valves which would prevent the air from reentering the system when the pressure dropped to atmosphere. The pressure must, therefore, fall below atmosphere, thus forming a partial vacuum in the system. The amount of vacuum produced will, of course, depend upon the condition of the fire in the boiler. The more the fire is banked and checked, the higher will be the vacuum formed or, in other words, a condition of equilibrium must be established.

If the system were perfectly sealed so that no air could reenter at any point, the entire system would be filled with steam at whatever vacuum were produced. If this were not the case it can readily be seen that an unequal pressure would exist at different sections which would be practically impossible, as steam would immediately flow to those points of lower pressure. The condensed water would flow back to the boiler in

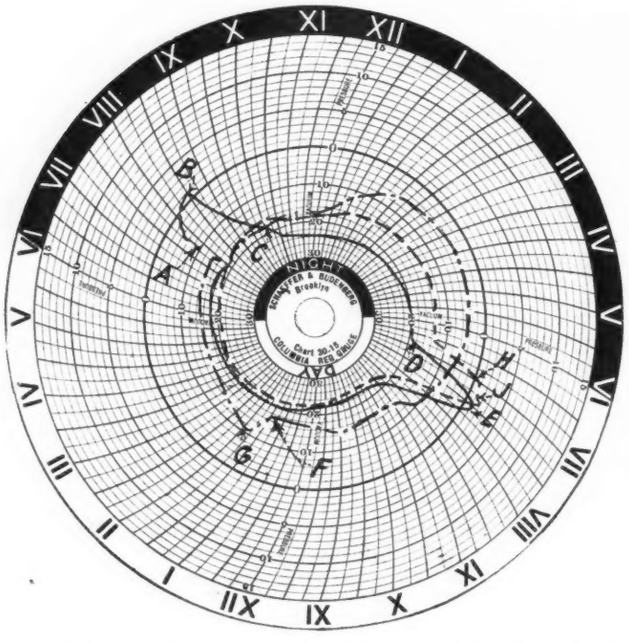


CHART SHOWING OPERATION OF HEATING SYSTEM IN WRITER'S RESIDENCE.

the same manner as when operating under pressure, as the laws of gravity are the same under a vacuum as under a pressure.

OPERATION OF A TYPICAL SINGLE-PIPE GRAVITY STEAM SYSTEM

The accompanying chart, taken from a recording pressure and vacuum gauge, shows graphically the conditions described above. The chart was taken from the system installed in the writer's residence, which consists of a single-pipe gravity return system. Each radiator is equipped with a Hoffman vacuum air valve and a packless radiator valve. The boiler is controlled by means of a thermostat located in the main living room.

The chart shows three days' continuous operation and nothing was done to the boiler or system during that time, except to coal the boiler at the required intervals and remove the ashes.

The thermostat is also equipped with an alarm clock which opens the drafts at the required time in the morning.

The chart was placed on the gauge at 7:45 P. M., represented by point A, when the vacuum on the system was 10 in. The drafts had just been opened a short time previous to this and the pressure was rising. At 7:30 P. M, or point B, the room temperature had reached 70° and the thermostat closed the drafts. The pressure immediately began to drop, as indicated by the curved line B-C.

It should be noted that the curve between the points B and C is perfectly regular and that there is no variation at the point where it crosses the zero or atmospheric line. This demonstrates graphically the point brought out before, that there is no distinction between pressures above and below atmosphere, as far as the inside of the system is concerned.

At 10:15 P. M. on the first day, or at point C, the fire was banked for the night. This is indicated by a slightly more rapid drop in the pressure, due to the decreased rate at which the steam was produced. The vacuum reached a maximum of approximately 24 in. at midnight and remained nearly constant for a period of about two hours. The rate of condensation in the radiators just equalled the rate of steam production in the boiler through this period.

At 1:30 A. M. the pressure began to rise slightly, due to the fact that the fire had begun to burn through and increase the rate of evaporation in the boiler. There was, of course, a small amount of air infiltration, but not enough to show any appreciable variation during this short period.

At 6:45 A. M., or at point D, the alarm clock opened the drafts, which is indicated by the sharp rise in the curve. At 7:35 A. M. the room temperature had reached 70° and the thermostat closed the drafts.

The outside temperature was very mild throughout the entire day and the thermostat kept the drafts closed until about 6:30 A. M. of the following morning when they were opened by the alarm clock.

An interesting feature will be noted at point F at 1:30 P. M. on the third day. The thermostat called for more heat when the vacuum on the system was 17 in. At approximately 1:45, or fifteen minutes later, the room temperature had reached 70° and the pressure on the system had risen only to 10 in. of vacuum. This answers very conclusively the question whether or not steam will circulate under a vacuum.

Another interesting feature to be noted in connection with the chart is that portion of the curve above the atmospheric line. At point H the curve crosses the atmospheric line and the pressure rises to approximately 1 lb. gauge. The pressure then remains constant at 1 lb. for a period of fifteen minutes and, at the point J, a sharp rise in pressure is noted.

During this 15-min. period of constant pressure the air, which has gradually leaked into the system while under a vacuum, is being expelled. As soon as the air is entirely expelled the pressure begins to rise. That portion of the curve above the atmospheric line on the previous day, indicated at the point E, also follows practically the same course, although it will be noted that a

considerably shorter period was required to expel the air. This is due to the fact that the system had been operating under a vacuum for a shorter period preceding this time and the amount of air infiltration was less.

(*Further discussion of this subject will be found under "Correspondence" on page 68.*)

Humidity Requirements for Residence

Many of the popular misconceptions regarding the amount of evaporation necessary in an average residence to maintain proper humidity conditions are answered in this paper which was prepared as a direct result of the publicity campaign on the part of several general magazines bearing on the degree of humidity necessary for physical well-being, the amount of water vapor required and the means of evaporating water in sufficient quantities for adequate humidification. The paper in full was presented at the recent annual meeting of the American Society of Heating and Ventilating Engineers.

Mr. Kratz points out, in the first place, that a relative humidity of about 40% is as high as it is practical to maintain where residences are concerned. If the humidity is much higher than this, the condensation on the windows will be excessive unless double windows are used. He gives as an approximate rule, that for single windows the numerical value of the relative humidity may be as high as the mean between the indoor and outdoor temperatures before the condensation on the windows becomes excessive.

The key to the problem is furnished in a "Humidification Chart" giving the amount of water in gallons per hour required to humidify 10,000 cu. ft. of space.

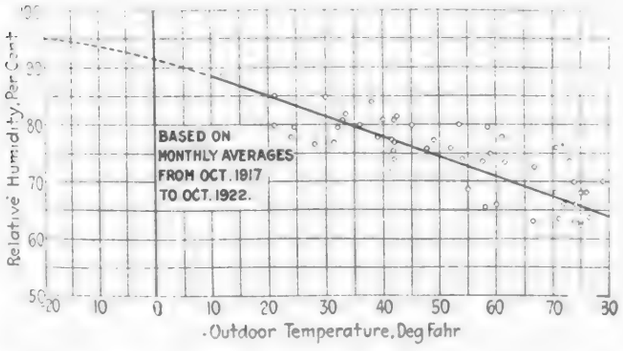


FIG. 1—MEAN MONTHLY OUTDOOR RELATIVE HUMIDITY AS OBSERVED AT UNIVERSITY OF ILLINOIS, URBANA, ILL.

The formula on which the chart is based is as follows:

$$G = \frac{VAd}{8.34}\left(\frac{r_1 w_1}{100} - \frac{r_0 w_0}{100}\right)$$

Where G = Gallons of water required per hour to humidify the house.
V = Volume of the space heated in cu. ft.
A = The number of air changes per hour caused by leakage of air from the outside.
d = Density of the air inside the house.
r_1 = Relative humidity indoors in per cent.
r_0 = Relative humidity outdoors in per cent.
w_0 = Weight of water vapor in 1 lb. of saturated air at the temperature indoors.
w_1 = Weight of water vapor in 1 lb. of saturated air at the temperature outdoors.

In calculating the "Humidity Chart," the value for the relative humidity outdoors r_0 was taken from the outdoor relative humidity curve, which has been transferred to the "Humidification Chart." It was assumed that the temperature maintained in the house was 69°

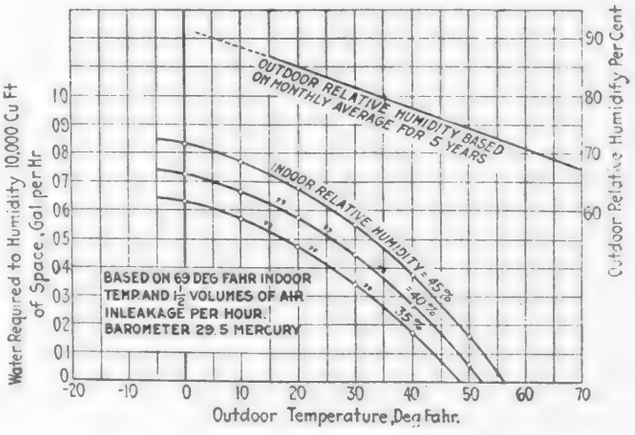

OUTDOOR RELATIVE HUMIDITY BASED ON MONTHLY AVERAGE FOR 5 YEARS
INDOOR RELATIVE HUMIDITY = 45%
40%
35%
BASED ON 69 DEG FAHR INDOOR TEMP AND 1½ VOLUMES OF AIR INLEAKAGE PER HOUR. BAROMETER 29.5 MERCURY
Water Required to Humidify 10,000 Cu Ft of Space, Gal per Hr
Outdoor Relative Humidity Per Cent
Outdoor Temperature, Deg Fahr.

FIG. 2—THE KRATZ HUMIDIFICATION CHART.

F. and that the number of air changes per hour due to inleakage was 1½. The values of w_1 and w_0 were taken from the table of mixtures of air and saturated water vapor given in Goodenough's "Properties of Steam and Ammonia." The volume, V, was taken as 10,000 cu. ft. When these values are substituted, the formula becomes:

$$G = 1.35\ (r_1 w_1 - r_0 w_0)$$

For example, for a relative humidity indoors of 40% and an outdoor temperature of 20° F.:

$$G = 1.35\ (40 \times 0.01524 - 85 \times 0.00214) = 0.578$$

In order to use the chart, a reasonable value is first chosen for the minimum outdoor temperature. This should be the same as the outdoor temperature upon which the design of the heating system is based. After determining the proper relative humidity indoors, the amount of water required to be evaporated per hour may then be read from the "Humidification Chart." This, pointed out Professor Kratz, gives the humidity required for the daytime, during which the temperature to be maintained is 69° F. and is the maximum demand for the evaporative performance of the humidifier.

In the case of a warm-air furnace system, when the outdoor temperature increases, the temperature at the register faces decreases. The evaporation, therefore, will become less and tend to compensate for the fact that less water is required when the outdoor temperature is higher.

For example, in order to humidify a house of 15,000 cu. ft. capacity so that it is comfortable at 69° F., with an outdoor temperature of zero, the indoor relative humidity should be maintained at about 40%. Reference to the "Humidification Chart" will show that an evaporation of 1.5 x 0.725 = 1.09 gal. of water per hour will be required of the humidifier during the daytime.

Aerology for Amateurs and Others

The Evolution of Modern Ventilation and Its Effect on Present and Future Practice

By E. VERNON HILL

II—Health and Comfort Factors

THE old theory of ventilation was founded on the belief that certain unknown, but decidedly harmful, substances were present in respired air. Therefore, the ventilation practice that logically developed was to remove the foul air, so-called, and replace it with fresh air, so-called, from out of doors. These terms, foul air and fresh air, held an important place in the literature. They were used continually in practically all discussions of ventilation problems. How to remove the foul air and how to replace it with fresh air was practically the only important factor to be discussed. Foul air was usually considered as air that had been contaminated by human respiration and fresh air its antithesis. Fresh air, by the way, must always be obtained from out of doors and strict laws in various states were in effect to prevent the fresh air from being taken from any place inside the building. These terms still encumber our literature and prevent to a great extent, the proper appreciation of what ventilation means at the present time and what really can be accomplished by properly-designed mechanical equipment.

The word "ventilation" itself has, on account of the derivation, a fixed and unalterable meaning, viz., to "blow through" or to "blow gently." It is closely tied to old and worn-out conceptions and for this reason the writer suggested, some years ago, at one of the annual meetings of the American Society of Heating and Ventilating Engineers, that it be discarded and the word "aerology" substituted.

Very material progress has been made during the last twenty years in the study of air conditions and the emphasis now rests on the physical, rather than on the chemical or bacteriological, constituents of the air.

The work of many investigators in this country and abroad, particularly the epoch-marking work of Flügge in Germany and Leonard Hill in England, demonstrated conclusively that the question of physical comfort in improperly-ventilated rooms was due to undesirable physical conditions, viz., the wrong combination of temperature, humidity and air motion, rather than to harmful effects of some exhaled poison, and the other factors that affect air conditions have been given little consideration.

SWING OF PENDULUM IN SCIENCE

The pendulum of fashion swings from one extreme to the other. A short time ago, milady's skirt swept the streets and no arguments on the part of the sanitarian could influence her. Later, its startling abbreviation was brought about, not by the dictates of hygiene, but by Dame Fashion. We have observed the pendulum in politics, swinging from the monarchial despotism in Russia to the other extreme, the Soviet government. The pendulum in science also swings from one extreme to the other, although we are not always willing to admit it and the extreme is noted in the science of ventilation when the emphasis is placed on the physical condition of the air alone, rather than on *all* the factors that enter into the problem.

Leonard Hill, in his report of the experiments conducted in the Physiological Laboratory of the London Hospital Medical College, makes the statement quoted in the previous chapter:

> "Heat stagnation is, therefore, the one and only cause of the discomfort and all the symptoms arising from the so-called vitiated atmosphere of crowded rooms are dependent on heat stagnation. The moisture, stillness and warmth of the atmosphere are responsible for all the factors and *all the efforts* of the heating and ventilating engineer should, therefore, be directed toward cooling the air in crowded places and cooling the bodies of the people by setting the air in motion by means of fans."

This, we believe, is an extreme position.

FACTORS AFFECTING PHYSICAL CONDITION OF THE AIR.

The physical condition of the air is of great importance and is the determining factor in so far as immediate physical comfort is concerned. We cannot, however, safely neglect the dust content of the air, the bacteria, pathogenic or otherwise, it may contain, odors that may be present, an excessive amount of carbon dioxide, a deficient supply of oxygen or the presence of other deleterious gases or substances.

The rational middle ground is to consider all of the factors that enter into the problem and to give to each its proper weight as a part of the whole. These factors are:

First: Temperature, humidity and air motion
Second: Air dust
Third: Air bacteria
Fourth: Odors
Fifth: Carbon dioxide

These will be discussed in the order named.

1.—Temperature, Humidity and Air Motion

In the previous chapter we pointed out the relationship between temperatures, humidity and air motion and advanced certain arguments and experiments tending to show why the wet-bulb temperature is the determining factor in comfort.

The writer is convinced that this proposition is fundamental and that its proper conception and acceptance is necessary in order that we may pre-determine definitely what combination of conditions is desirable for health and comfort and how far, or to what extent, uncomfortable conditions vary from the ideal. It

is quite generally conceded that a wet-bulb of 56° F. is ideal under ordinary conditions of temperature and humidity; viz., a temperature of 70° F. and a relative humidity of 40%, but the experiments from which the comfort curve, as given in the preceding chapter, was plotted were somewhat crude, owing to the lack of delicate testing apparatus and proper equipment and the true values are consequently indefinite.

The writer brought this matter to the attention of the American Society of Heating and Ventilating Engineers in 1917 and at several subsequent dates, requesting that this work be taken up at the Research Laboratory and more accurate information obtained as to the relation of the wet-bulb to comfort, the true comfort curve for persons at rest, doing light, moderate and hard work.

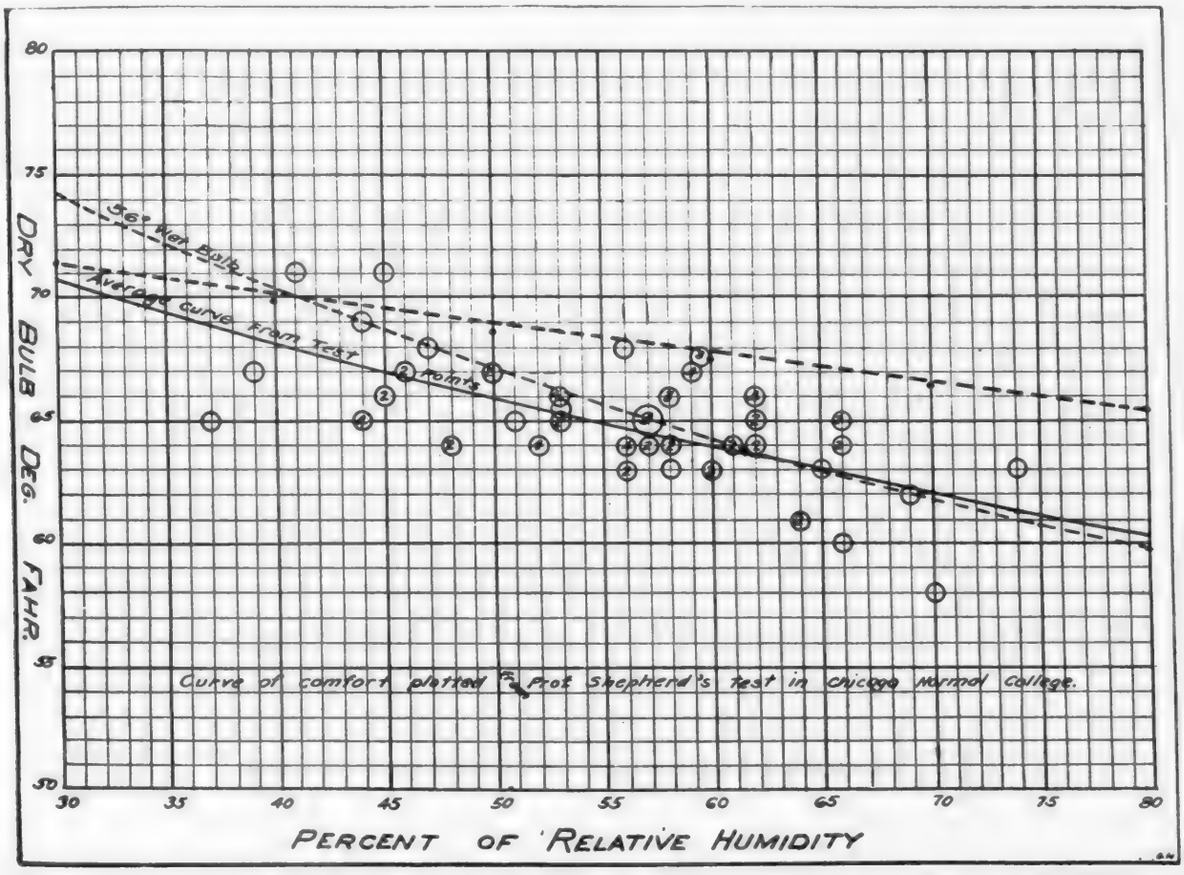

DRY BULB DEG. FAHR.
PERCENT OF RELATIVE HUMIDITY
56° Wet Bulb
Average curve from test
Curve of comfort plotted from Prof. Shepherd's test in Chicago normal college.

FIG. 5.—COMPARISON OF SHEPHERD COMFORT CURVE AND RESEARCH LABORATORY'S EQUAL COMFORT LINE.

THE RESEARCH LABORATORY'S "EQUAL COMFORT" TESTS.

Recently the laboratory has undertaken experiments with this end in view and has prepared a chart giving lines of equal comfort from 30° F. to 115° F.

The accompanying illustration shows three curves, first, a curve drawn through the center of Prof. Shepherd's zone of comfort; second, the wet-bulb curve of 56° F., and, third, the Research Laboratory's equal comfort line that crosses 56° wet-bulb curve at a temperature of 70°. It will be noted from the illustration that the Research Laboratory curve is practically a straight line, that it falls between 56° wet-bulb and Shepherd's comfort line at humidities between 30% and 40%, but that at high humidities it indicates a higher temperature as being comfortable for the same humidity.

Two rooms called the Psychrometric Rooms were constructed specially for work of this kind at the Research Laboratory. The walls are of 4 in. cork slabs, with no openings except for the entrance door. Carrier equipment and control is provided to maintain any desired temperature and humidity.

The first room, which we will call Room A, is maintained at a constant temperature and humidity. In the second room, which we will call Room B, the temperature and humidity are varied during the experiments. The observers remain for a certain length of time in Room A until they become acclimated. Then they pass to Room B where the temperature conditions are higher or lower, as the case may be. The variation in Room B from the conditions in Room A is only sufficient to give a different temperature perception on the part of the observer, first, lower than Room A and then higher than Room A and the mean between these two points is taken as the point of equal comfort.

POSSIBILITY OF ERROR IN FIRST SENSE IMPRESSIONS.

The writer is of the opinion that the so-called equal comfort lines, as determined by the Research Laboratory, are not equal comfort lines in the true sense because they were determined by *immediate* perception of temperature variations. The face and hands, particularly the backs of the hands, assuming that the body is clothed, are the surfaces primarily or immediately affected by temperature difference of the air and the sensations registered immediately in entering a room with a different temperature is determined—first, by the dry-bulb temperature difference in the room and outside of it; second, by the previous condition of the skin, due to its adjustment to air conditions before entering the experimental room; third, by the moisture con-

tent of the air. The third factor to operate, viz., the moisture content, is only immediately effective if the face and hands carry distinct visible perspiration.

In order to determine relative conditions of comfort, I believe it is essential that the observer stay in the room where observations are being made a sufficient length of time, not only to readjust the exposed skin surfaces to the new conditions, but to aerate the body covering in order that the conditions of changed temperature and humidity may be brought into play and effect over the entire body surface. This probably requires, in still air, from thirty minutes to one hour. The equal comfort lines, so called, therefore, are not in the opinion of the writer equal comfort lines, but, on the contrary, lines of *immediate temperature sense impression.*

When the line of maximum comfort is finally definitely established, the writer is strongly of the opinion that it will fall very close to the 56° wet-bulb temperature, modified necessarily by individual characteristics,

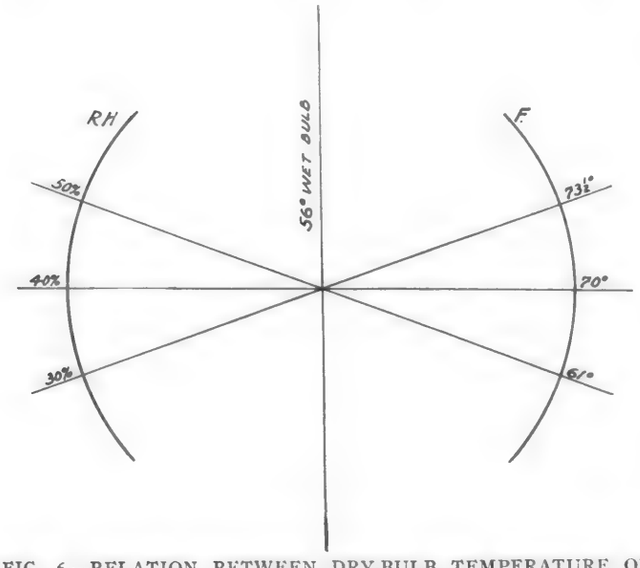


FIG. 6.—RELATION BETWEEN DRY-BULB TEMPERATURE OF THE AIR AND THE RELATIVE HUMIDITY FOR A CONSTANT WET BULB.

by the clothing, by the season of the year, by the radiation factor and by the air motion.

The reader may feel that the numerous variations make the comfort curve of little value but when we consider the wide range of adjustment the body is capable of maintaining, through its temperature-regulating mechanism, we are forced to conclude that if the wet-bulb rule is basically sound, it always falls within the zone of comfort made possible by the heat-regulating mechanism of the body.

Armspach has shown conclusively that the rate of heat dissipation from the kata-thermometer, or from any wet-bulb instrument, depends entirely upon the wet-bulb temperature of the air; in other words, the heat loss is constant for any combination of temperature and humidity so long as the wet-bulb is constant.

HUMAN BODY A WET KATA-THERMOMETER

The human body is, to all intents and purposes, a wet kata-thermometer, giving off heat by convection, evaporation and radiation. The rate of heat loss from a wet-bulb instrument by convection and evaporation depends entirely upon the wet-bulb temperature of the air. The heat loss by radiation is not directly affected by the air, but by the difference in temperature between the instrument and the surrounding walls or other objects. However, as the wet-bulb temperature of the air affects the surface temperature of the wet-bulb instrument, the rate of heat loss by radiation is also affected to this extent.

AVENUES OF HEAT LOSS FROM THE BODY

Vierordt gives the following table as to the avenues of heat loss from the body in twenty-four hours. The original figures are in calories but for the benefit of the heating and ventilating engineer, I have changed them into British thermal units.

The table is as follows:

By urine and feces,	1.8% =	192	B.T.U.
By expired air, warming the air	3.5% =	336	"
By evaporation, air from the lungs,	7.2% =	728	"
By evaporation, from the skin	14.5% =	1,456	"
By radiation from the skin	40% =	3,992	"
By convection	23% =	3,176	"
Total daily loss		9,984	B.T.U.
Loss per hour		416	B.T.U.

Vierordt's original figure for radiation and conduction from the skin is 73%, or 7,168 B.T.U. No one knows what percentage of this is radiation and what percentage convection. Carrier states that he assumes 40% and I have substituted this figure in the table for radiation losses, leaving 23% for convection.

It will be seen from the table that by far the greatest percentage, viz., 73% of the total heat loss, is through the skin. Deducting, however, the 40% by radiation, we have 23% by convection from the skin surfaces and 25.2% by evaporation from the skin and lungs and warming the expired air.

No one questions the fact that the heat loss from the lungs, both by evaporation and warming the respired air, depends entirely on the wet-bulb temperature. No one questions the fact that the heat loss by evaporation from the skin depends entirely upon the wet-bulb temperature. We, therefore, have it established that 25.2% of the heat loss depends absolutely on the wet-bulb and that the remaining 23%, assuming that this figure is correct for heat loss by conduction from the skin, only is in question, and this must depend upon the wet-bulb if the skin surface is covered with moisture. It only remains, therefore, to determine to what extent the skin surface is covered with moisture in order to find how close the body responds as a wet kata-thermometer.

SKIN SURFACE USUALLY MOIST

In ordinary air temperatures, the skin surface underneath the clothing is wet, or at least moist. Demonstrable perspiration is practically always present in the regions of the axillæ and other portions of the surface and it is entirely probable that the film of air in actual contact with the skin is saturated, or practically so. If this is true, the body must act as a wet-bulb and heat loss consequently comfort determined by the wet-bulb

temperature of the air. The extent to which the body varies from the true wet-bulb determines the variation of comfort conditions from the wet-bulb temperature.

ILLUSTRATION OF EFFECT OF WET-BULB TEMPERATURE ON COMFORT.

Let us go a step farther and make practical application of this conception of the wet-bulb temperature in its relation to comfort. Fig. 6 is an illustration of the relation between the dry-bulb temperature of the air and the relative humidity for a constant wet-bulb. With a wet-bulb of 56° and a dry-bulb temperature of 70°, the relative humidity is 40%. (Note the horizontal line on the chart.) If the humidity is increased to 50%, the dry-bulb temperature should be reduced to slightly less than 61° or if the humidity is reduced to 30%, the dry-bulb, to maintain a constant wet-bulb, must be increased to 73½°. If the humidity drops to 20%, the dry-bulb will be nearly 78½°.

These are the relations necessary between the temperature of the air and the relative humidity if a constant wet-bulb of 56° is maintained and it is a matter of common knowledge that these high temperatures are necessary for comfort during cold weather in apartments or rooms where artificial humidification is not employed. It is also possible to go below a temperature of 70°, provided the humidity is increased in conformity with the wet-bulb requirement and still maintain bodily comfort. However, there are certain practical objections that render this somewhat undesirable.

For example, take a winter day when the outside temperature is 20°F. above zero. With an outside relative humidity of 80%, we have a dew point of 15°. Suppose that we wish to maintain an indoor temperature of 60° which, with 56° wet-bulb, would require a relative humidity of 53% and a dew-point of 42½°. With a dew-point out of doors of 15° and a dew-point inside of 42½°, we would have a very heavy condensation of moisture on the windows, which would be objectionable as the temperature of the inside of the glass is usually about half-way between the inside and outside temperature of the air.

A TYPICAL TEST.

A test was made in my office on a January day when the outside temperature was 40° F., the inside 74°. The temperature of the glass was 57½°, practically one-half of the difference between the two. We must, therefore, increase the temperature in the room and decrease the humidity until this objectionable feature is overcome. With a temperature in the room of 70° and a relative humidity of 40%, we have a dew-point of 44½°. With an outside temperature of 20°, the temperature of the inside of the glass will be 45°. This, therefore is the highest humidity under these conditions that is desirable.

(To be continued)

Precipitation of moisture from clouds and the disappearance of the clouds themselves have been caused by the dropping of electrically-charged grains of sand upon them from airplanes, according to recent tests conducted at McCook Field through the co-operation of the Army Air Service.

Suggestions for Underground Storage of Coal at the Mines

Storage of coal underground at the mines is suggested by Director H. Foster Bain of the Bureau of Mines as a practical step toward the accumulation of those reserves of fuel which are necessary to stabilize industry and to protect the domestic consumer in periods of acute coal shortage, such as the country has recently undergone.

The seasonal demand for coal can to some extent be met by storage, but this must be done by the consumer or by some distributing agent operating between him and the mine, says Dr. Bain in a report made to the United States Coal Commission. At the mines the best place to store coal is in the ground and with unimportant exceptions it is not feasible to provide more than a limited amount of storage above ground.

The anthracite companies established near points of consumption a system of great storage piles which were valuable balance wheels to the trade and have facilitated that steadiness of operation which distinguishes anthracite from bituminous mining. Large-scale storage of bituminous coal has been less practicable because the uncertainty as to future price—a result of the excess capacity of the mines and the keen competition—has deterred companies and individuals from making the necessary investment. The same factors tend to discourage individual consumers from storing in summer coal that will not be burned till winter. In periods of advancing price or of anticipated shortage, however, as much as 60,000,000 tons of bituminous coal has actually gone into storage. This is enough under normal conditions to stabilize the industry and also to contradict effectually those who doubt the technical feasibility of storing soft coal.

With proper selection of the coal and due attention to modest requirements as to methods, it is entirely practicable to store large quantities of most coal at moderate cost, continues Dr. Bain. The risk is in the uncertainties as to future price, as the mine and railway equipment of the country is extensive enough to allow industry, except under unusual conditions, to obtain adequate supplies direct from the mines. Coal shortage and car shortage is a local matter in normal years. The nation has put men and money into coal mining and the railways to meet peak loads rather than provide a less amount of capital for coal storage and so insure steady and economical operation. The whole problem of coal storage has recently been reviewed by H. H. Stoek, consulting engineer to the Bureau of Mines, and a report is being prepared which will place the facts at the disposal of all persons interested.

In Table 7 is collected for comparison and convenient reference the average power figures given in Tables 1 and 6.

In addition to the average unit cost by groups, as shown in the tables, the following are the average unit costs for all plants reporting:

Coal	$6.46 per ton, 0.323 cents per pound.
Steam	85c. per 1000 lbs., 0.085c. per pound.
Electricity	2.68c. per K. W. H.
Engine-room labor ..	66.9c. per hour.

New Developments in Smokeless Combustion

BY H. M. NOBIS

COMBUSTION is said to be complete when the combustible elements have united with all the oxygen with which they are capable of entering into a combination, provided the ignition temperatures are high enough.

It would be foolish on my part to claim a perfect combustion in a heating boiler, but we certainly should strive to have a complete combustion. While combustion is complete but not perfect, there are losses due to excess air and it follows that the more nearly complete combustion can be made to approach perfect combustion, the less the loss that will occur in the burning of any fuel.

The majority of the schemes employed for smokeless combustion consists of admitting excess air before, above, behind and through the bridge wall. It is a debatable question with some engineers where the proper inlets for the air supply should be located and where the contact point between the gases and air should occur. However, I express my firm opinion that the air inlet should be above the fuel bed, no matter what type of heating boiler is used. The air inlets should consist of openings with shutters which could be closed after the smoke is burned off. In ninety-nine cases out of one hundred, this is not done and, as the heavy smoke burns off in about fifeen minutes and the average firing period is two hours, the cold air may do more harm than good.

My experience is that it is easier to prevent smoke by manipulating the fire door, giving a large amount of air at first, gradually diminishing and then closing it off entirely. As all the above-mentioned air-inlet methods produce a delayed combustion in the boiler flues and chimney, the writer has compiled the following rules to achieve a good and smokeless combustion:

SUGGESTED RULES FOR SMOKELESS COMBUSTION

1. The introduction of hot excess air above the fire, first in large quantities, gradually diminishing, and shutting off entirely in 10 minutes.

2. Methods to compel a thorough mixing of the heavy smoke with the heated excess air above the fire, allowing a certain period of time to complete the consuming of the heavy smoke.

3. The presence of heat-storing materials which absorb a part of the high heat generated during the smoke-consuming period above the fire, which storage heat may be used to ignite the lighter combustible gases.

4. Means to insure a thorough mixing of these lighter gases with the unavoidable air inleakage along grate supports, fire holes, doors, etc.

Acting on these principles the writer constructed an apparatus shown in the accompanying illustrations which he installed in a 36-series, 9-sectional National Radiator Company boiler. The coal burned comes from a Belmont County (Ohio) mine containing about 39% volatile matter, 47% carbon, 4% sulphur and 10% ash, having a heat value of about 12,900 B. T. U. This coal is burned on 15½ sq. ft. of grate surface, with draft produced by a chimney 18 in. x 18 in. x 55 ft. high. The direct radiation attached to the usual vapor system piping is in excess of 4000 sq. ft.

To fulfill the principle of the first requirement, we installed 4-in. heavy cast-iron piping on both sides of the furnace. These pipes are supported by the extended water tubes found in these boilers. The method adopted for introducing the excess air is shown in Fig. 3. This apparatus consists of an enlarged toilet tank, the water contents being discharged into the ashpit before the fireman begins to add fuel or stoke the fire. The copper float sinks with the water level, closing an automatic float switch which supplies current to a direct-connected blower, as shown. The air discharge is connected to the 6-in. cast-iron pipe leading inside the furnace. An orifice in the city water supply line to the flush tank fills the tank in from 10 to 20 min., lifting the float which breaks the current to the motor. The partition of the tank being submerged partly in water closes the air inlet to the blower. The partition is made with a V-cut opening, diminishing the air supply gradually during the blower operation, giving a large amount of excess air at first.

The second requirement is solved in the following manner: The outlet openings in the blower discharge pipes

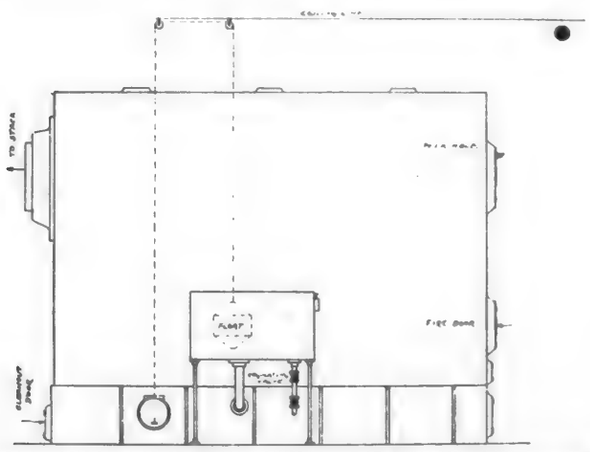


FIG. 1.—AUTOMATIC AIR CONTROL FOR SINGLE-GRATE BOILERS.

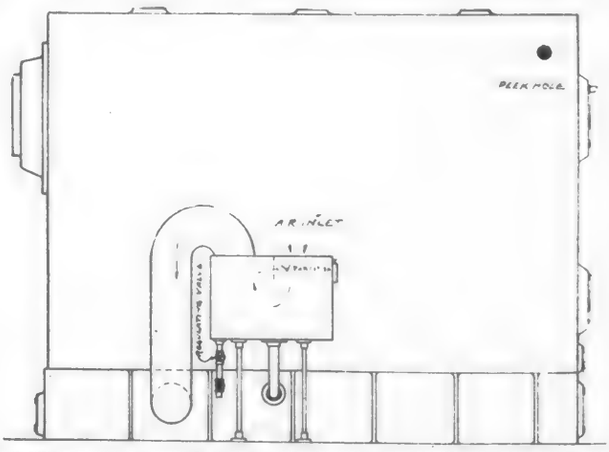


FIG. 2.—AUTOMATIC AIR CONTROL FOR SECTIONAL CAST-IRON BOILER ARRANGED FOR SMOKELESS COMBUSTION.

inside the boiler (Fig. 4) are slanted sidewise so that the escaping air stream blows against the fuel bed. The maximum amount of the air is released at the pipe ends blowing across the fire door, preventing to a certain extent, the inrush of cold air as the fireman starts the blower before the fuel charge. This forced-in air creates above the fuel bed a very lively commotion, burning the soot and smoke above the fire and not in the flues.

Introducing the heated air above the fire checks, to a certain extent, the rapid flow of air through the fuel bed, retaining the combustible gases, such as methane, ethane, acetylene, etc., within the fuel bed, these being burned off later on.

The partitioned-off bridge wall prevents the rapid flow of the smoke which is given time to burn above the fire, thus developing a high temperature at that point.

The third and fourth principles are mostly covered under the second requirement, with the addition of utilizing the thread-like inside formation of the round firebrick as a mixing medium for the gases. Fig. 5 shows the firebrick construction.

The above-described method has been found to produce very satisfactory results:

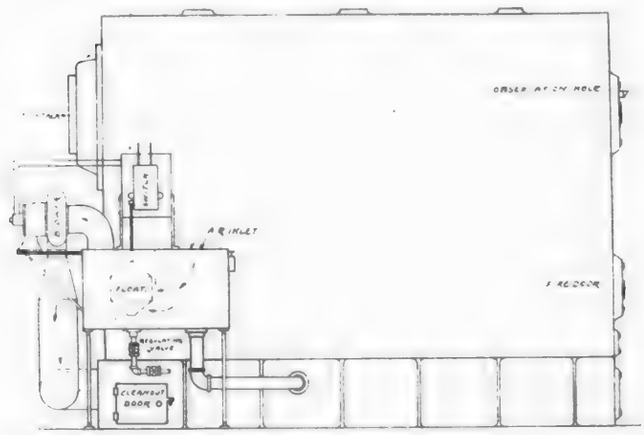


FIG. 3.—BLOWER TYPE OF AUTOMATIC AIR CONTROL FOR SECTIONAL CAST-IRON BOILER ARRANGED FOR SMOKELESS COMBUSTION.

1. The smoke or soot is actually consumed, producing and maintaining exceptionally clean furnace walls and flues.
2. A higher temperature is maintained within the furnace, found especially after a banked fire.
3. A steadier steam supply.
4. Less and smaller clinkers due to the wet ashpit.
5. Clouds of light gray smoke, at first with a small continuous escape of vapor-like smoke curling from the chimney.
6. A saving in fuel.

Figs. 1 and 2 show the automatic arrangement which may be applied to single-grate boilers with side air inlets. The writer has developed a similar apparatus for use in firebox steel and return tubular boilers.

HELPFUL ADVICE NEEDED ON SMOKELESS COMBUSTION

Referring to the smoke ordinances of cities which permit only the use of down-draft boilers, these, in the writer's opinion, are laws which do not comply with the spirit of our Constitution. These laws should not stand in the way of improvements which are bound to come, nor should a community compel a man to burn a certain

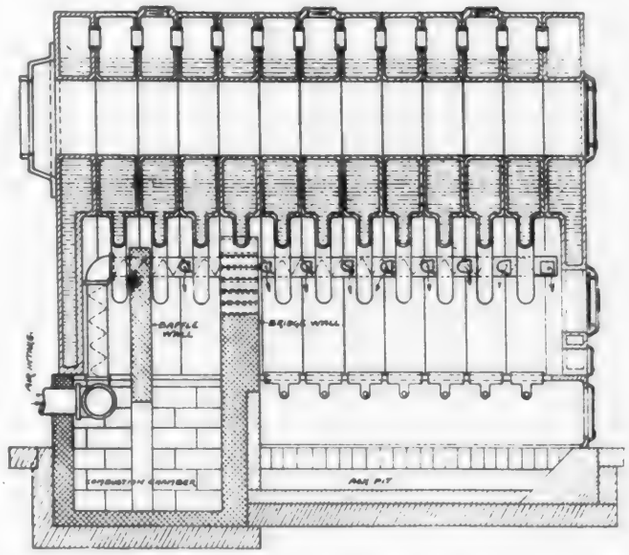


FIG. 4.—SECTIONAL CAST-IRON BOILER ARRANGED FOR SMOKELESS COMBUSTION.

grade of fuel. What a community should do is to give to the plant owners, which emit objectionable smoke from their stacks, helpful advice. This helpful advice can be given by competent combustion engineers, but to the shame of our city governments, men with little knowledge of combustion principles in many cases, are appointed as chief smoke inspectors. Lack of finances is given as the cause for this condition. If every community with a smoke problem would have expended its money on real education, consisting of an appeal for cleanliness, the money expended would have been saved one hundred fold through the saving in trees, flowers, washing of buildings and in freight rates.

The law as it stands, operates only during the office hours of the inspectors. Everyone who is acquainted with large and small boiler operations knows that most of the objectionable soot is deposited on the damp and

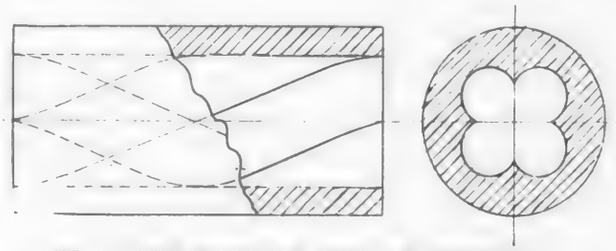


FIG. 5.—FIRE BRICK FOR FURNACE BRIDGE WALL.

wet surfaces of buildings and vegetation, in the early morning hours.

The smoke and soot blown over a city in the morning does the real harm on account of the low furnace temperatures prevailing after a banked fire. These low furnace temperatures cannot burn the sulphur, etc., out of the flaky smoke, which will burn out of the fuel after the boiler capacity is reached.

The time is coming fast when certain steel-producing districts will be able to furnish coke at less cost than soft coal, owing to the valuable by-products gained. Lucky will be the owners who provide large coke-storing space, so that he may buy his fuel requirements during the summer months when great quantities are available at a reduced price.

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IN THE conduct of any specific research work the importance of focussing attention on fundamentals is generally recognized. Basic laws governing the phenomena under investigation are what is desired. Once we know the correct theory to follow, it will be possible to adapt theory to practice in given conditions and make such modifications as are necessary. In the case of the Research Laboratory of the American Society of Heating and Ventilating Engineers, the revisers of the society's Constitution took pains to state that "the work . . . shall be confined to a determination of the basic or fundamental principles and laws underlying all matters in the field of heating and ventilation relating to the health or comfort of the human system."

As the work has developed, however, the point has been reached in more than one investigation where the Research Laboratory has been able to draw certain conclusions which would greatly benefit the entire industry if they were authoritatively expressed. For instance, in the tests on the capacities of steam risers as affected by critical velocities of steam and condensate mixtures, the laboratory will be able to state definitely the limits that may be followed in actual practice. Again, considering such tests as those made by the Bureau of Standards on radiator return-line valves, if similar tests are made by the laboratory, as is proposed, it may be expected that the laboratory will be able to formulate a code, similar in a general way, to the A. S. M. E. Boiler Code, defining at least a standard method of testing such devices. It is even proposed that the Research Laboratory, following again the procedure of the A. S. M. E. Boiler Code, indicate, with its stamp of approval, such valves as meet the requirements of its code.

While such a course would need to be carried out with watchfulness and care, it is a significant sign that it is being discussed among those close to the Research Laboratory. Up to the present time there has been a widespread impression, even though unjustified, that the laboratory devotes too much of its time to establishing refinements of theory which at best are of limited practical value. The development of methods of testing, such as have been adopted by the fan manufacturers for their product, would bring home the practical benefits of the laboratory to everyone and incidentally would have an important effect in securing the support of those who are holding back, awaiting something more "tangible" to come forth from its investigations.

EXPRESSIONS of confidence that are being heard as to the continuation of the present business boom, as a rule, take little account of what many consider the most vital factor in the situation. This is the enormous increase in the issues of tax-free bonds on the part of states, cities and towns throughout the country, for every conceivable purpose, but mostly for building schools and other public buildings. Where the total indebtedness of states, cities and counties in 1913 was $4,500,000,000 it is now $9,000,000,000 and is increasing at the rate of $1,250,000,000 a year. Of course, the fact that the bonds issued are free from Federal taxes is the key to their ready sale, while the taxpayers are being lulled by the thought that the properties being built by the proceeds of the bonds will pay for themselves. The vital difference between a company whose earning power may be capitalized and a political division depending entirely on taxes for the payment of its obligations, seems to have been generally overlooked.

Although a bill is now pending in Congress making it possible for the Federal government to tax state, county and municipal bonds, it is necessary to accomplish this through a constitutional amendment and it is not expected by anyone that such an amendment can be put through within a period of less than two years. In the meantime the orgy of bond issues may be expected to continue but that it is economically unsound goes without saying.

A NEW analysis of the circulation of THE HEATING AND VENTILATING MAGAZINE reveals the interesting fact that no less than 39% of its readers are classified as distinctly heating and ventilating engineers. Nearly 18% are heating contractors. In addition, 8% are both engineers and contractors, while of the balance, 3% are central station heating engineers and superintendents, 2% are architects, 7% manufacturers and 10% manufacturers' agents. Thus, almost three-quarters of the magazine's circulation is made up of men whose activities are wholly confined to the design and installation of heating and ventilating apparatus, while 20% more are directly connected with the industry. Of the remainder of the circulation, 5% goes to libraries, the balance being miscellaneous.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Climax in the Research Laboratory's Program Successfully Met at the Society's 29th Annual Meeting in Washington, January 23-26

STANDING at the crossroads of Advancement and Retrenchment, with one way pointing towards a continuation and even an enlargement of its research program, and the other pointing towards a sharp withdrawal of its activities, the American Society of Heating and Ventilating Engineers met the issue squarely at its annual meeting in Washington, D. C., January 23-26, and "came through" in a way to gratify its most ardent supporters. The decision was made at the Research Session, on the third day of the meeting. Inspired by the words of its director of research, Dean F. Paul Anderson, the members, in a memorable rally, not only made up the difference, through voluntary subscriptions, between their research budget and the income actually received, but went further and made it possible even to extend the plans of the Research Laboratory.

The climax came when Chairman Thornton W. Lewis of the Committee on Research presented his report. He showed that while the Research Laboratory had been generously supported through the years of its existence, the lines of the income and outgo were rapidly reaching the crossing point and that unless further support was forthcoming immediately it would be necessary to curtail the work to a marked degree.

H. P. GANT

The New President of the American Society of Heating and Ventilating Engineers.

New York, through President Willis H. Carrier of the New York Chapter, started the ball rolling by underwriting subscriptions of the New York members to the extent of $2,000. Other chapters and individual members quickly fell into line, the Philadelphia Chapter, through President Frederick D. Mensing, guaranteeing to raise no less than $4,500. When all the additional subscriptions were tabulated they were found to total over $9,000, a result which aroused the highest enthusiasm. Chairman Lewis declared it was the happiest moment of his two years' connection with the work and President J. R. McColl announced that the work of the Research Laboratory would not only go on but would be enlarged.

The meeting itself was a splendid success, rivalling closely the society's banner meeting in Philadelphia two years ago. Two of the sessions were held in the assembly room of the United States Bureau of Standards and this in itself constituted a notable recognition of the position the society has attained as one of the leading scientific bodies of the country. In addition, the society was addressed by Secretary of Commerce Herbert Hoover, who spoke of the important place the engineer has come to occupy in the affairs of the nation and expressed the opinion that the solution of the economic ills of the world lies largely in his hands.

No less than thirteen formal papers were presented at the meeting on a variety of topics, while several members of the staff of the Bureau of Standards gave illustrated talks on some of the important investigations going on at the bureau of particular interest to heating and ventilating engineers.

Business Session, January 23.

President J. R. McColl opened the business meeting of the society in the Engineering Societies Building, New York, January 23. He made no formal address, but spoke briefly of the work accomplished during the year. He stated that he had visited all of the chapters, with the exception of Boston and Philadelphia, and had helped to organize the Toronto and Columbus Chapters. His principal recommendation was for the formulation of a heating and ventilating code, similar in a general way to the A. S. M. E. Boiler Code. This work, he said, should be undertaken by a special committee of the society. His suggestion was favorably acted upon at a later session.

The report of the council covered the work of the society's Research Laboratory and various committee programs. It was shown that there are no less than thirteen technical and conference committees engaged in various technical projects for the society.

Secretary C. W. Obert reported a total present membership of 1,659. He compared this number with 663 in 1916. Another interesting comparison was that the number of chapters has increased during that time from three to fourteen, without counting the two new chapters in Wisconsin and Columbus, Ohio. The total number of active committees of the society is 33. The society's gross income for the year including subscriptions for the support of the Research Laboratory, was $65,000. One of the interesting statements in his report was that hereafter the Guide, which is published annually by the society, will be handled from the headquarters office.

Treasurer Homer Addams presented the financial report, showing receipts for the year of $34,889 and expenses of $35,507. There is also a contingent liability of $6,000 for the publication of the past transactions. These figures were substituted in the auditor's report, presented by Chairman W. L. Fleisher, which contained also an analysis of the condition of the society financially, with recommendations for the coming year.

Under committee reports, that of the Publication Committee, C. L. Riley, chairman, brought out the fact that the income of the JOURNAL through advertising patronage was $9,100 and its cost of publication $9,600. The recommendation was made that the JOURNAL contain at least one article in each issue on the work of the Research Laboratory. Another was that beginning with the first issue of 1924 the JOURNAL be issued monthly. Still another was that the publication of the Year Book be discontinued as a separate publication and its contents included in the Guide. The Guide Publication Committee, it was added, should be appointed from the Publication Committee, with a sub-committee to solicit advertising space in the Guide.

NEW OFFICERS.

The report of the tellers, Messrs. Durand, Farrar and Ireland, showed the election of the following officers:

President, H. P. Gant, Philadelphia; First vice-president, Homer Addams, New York; Second vice-president, E. E. McNair, Detroit; Treasurer, William H. Driscoll, New York. Members of the council: Willis H. Carrier, Newark, N. J.; Joseph A. Cutler, Chicago; S. E. Dibble, Pittsburgh; E. S. Hallett, St. Louis; Alfred S. Kellogg, Boston; Thornton Lewis, Philadelphia; J. R. McColl, Detroit; and Perry West, New York. Members of the committee on research: C. F. Eveleth, S. E. Dibble, F. B. Howell, Thornton Lewis and William B. Reed.

Morning Session, Bureau of Standards, January 24.

Following the business meeting, the society started its professional sessions in Washington, the next day, headquarters were established at the Hotel Washington. An early start was made the next morning for the Bureau of Standards where a large gathering assembled for the first professional session.

Dr. F. C. Brown, acting director of the Bureau of Standards, extended a formal welcome to the society. The session was then devoted to some of the work going on at the bureau. In a talk by M. S. Van Dusen on "Heat Transmission of Building Materials," he described an apparatus which has been developed by the bureau for making tests of heat transmission through building materials. The apparatus has been christened a conductimeter. Mr. Van Dusen said that while the bureau hoped to secure figures for all of the ordinary types of wall construction, he felt the results would be of infinitely more value if they could be duplicated elsewhere with this particular set-up.

A. J. Hodge spoke on "The Testing of Anemometers." He said the tests had covered velocities up to 220 ft. per second, or 150 miles per hour, this limit being reached as airplane speed meters go up to that velocity. He confirmed the general experience that variation is likely at low velocities, making frequent calibration necessary. Anemometers, he said, can be sent to the bureau for calibration, a nominal fee for the work being charged. A question as to what differences there would be with the anemometer in a vertical and a horizontal position was answered by the statement that a vertical wind tunnel would be necessary in the former case, as all of the bureau's tests were made with the anemometers in a horizontal position. F. R. Still suggested the development of a new instrument to take the place of the anemometer and said the bureau should be rendering a great service if a new and better instrument could be devised. It is important, he said to mount anemometers on a thick board so as to make them as rigid as possible.

W. F. Stutz delivered an address on "Tests of Radiator Return Line Valves." Eight valves of this type have recently been tested at the bureau, three identical samples being used of each type. Three operating tests were conducted, one of six hours with steam pressure at 1 in. mercury, and vacuum in the return of 5 in.; one of three hours, with a pressure of 6 in. mercury and a vacuum in the return of 10 in.; and one of three hours, at 6 in. mercury, with atmospheric pressure in the return line. The radiator used was of the steam type, 25 sec. 2-col. 38 in. cast-iron. The tests were run to determine the temperature in the radiator, the rate of discharge and the rate at which steam was passed. Charts were shown on the screen giving the results of the tests, as well as a view of the layout, but as the valves were indicated only by letter, it was not possible to identify either the makes or types of the traps tested. In response to a question on this point, Mr. Stutz stated that the tests at least gave an indication of what could be expected from a correctly designed return-line valve.

In the discussion C. F. Eveleth said that ordinarily in tests of this kind, only the discharge of steam is recorded, and no account is taken of the water in the radiator. He endorsed the test methods as described by Mr. Stutz, but felt that an important additional factor was the operation of the trap under working conditions, with the presence of oil and dirt in the line. Still another factor, he said, was the life of the trap.

President McColl stated that the requirements of such a valve turned on (1) sealing pressure, (2) recession from seat, or working orifice, (3) durability and (4) simplicity.

J. A. Donnelly expressed the view that no traps are needed in the rooms and said he would put them on the basement ceilings. He endorsed the use of steam-

type radiators in the tests, as poor valves he said, will operate on water-type radiators.

Dean Anderson endorsed a suggestion made that the Research Laboratory could determine a standard method of testing radiator traps and they could then be stamped with the society's approval, very much as is done with boilers, under the A. S. M. E. boiler code. He said the fan code which was adopted by the manufacturers last summer is now being followed.

The session concluded with a talk on "Fire Tests of Structural Materials," by S. H. Ingberg.

Following luncheon, which was served at the bureau, those present were divided into groups of ten and assigned to guides who took them through the various buildings comprising the bureau. Due to the inclement weather with snow and rain falling heavily, the inspection assumed the proportions of an adventure, in which army trucks and other conveyances were requisitioned to convey the parties from building to building.

Evening Session, January 24.

Three papers on the heating and ventilating of important government buildings in Washington were scheduled for this meeting. One by C. R. Denmark was devoted to "Forced Circulation Hot Water Heating System in the National Museum." The second was a description of the "Heating and Ventilating System in the Bureau of Engraving and Printing," by Nelson S. Thompson. The third was devoted to "Fan blast Heating in the Gun Shop of the U. S. Navy Yard," by M. S. Cooley.

In addition, chairman J. E. Bolling of the Guide Publication Committee, presented an extensive report on the plans for the 1923 Guide which aroused a lively discussion. This year, he said, the Guide will be greatly enlarged, both in the matter of data pages and manufacturers' announcements. For the data section, various subjects have been assigned to individual members to work up in an effort to make the data thoroughly comprehensive.

A large part of the session was devoted to the society's finances based on the résumé of the New York business session.

Heating and Ventilating U. S. Museum

In plan the Natural History Building in Washington, better known as the new building of the National Museum, and located in the Smithsonian grounds, is a large pavilion in conjunction with a rotunda facing south, from which there radiate three wings, these wings being in turn connected at their outer ends by L-shaped ranges so as to form two completely-enclosed courts.

The building is a monumental structure four stories high, with a dome on the central pavilion rising to a height of 162 ft. Along the south front the building extends 561 ft. and along the north wall 499 ft., while along the east and west it is 313 ft. in length.

In order to gain a definite idea of the size of the building, the author stated that the cubic contents total

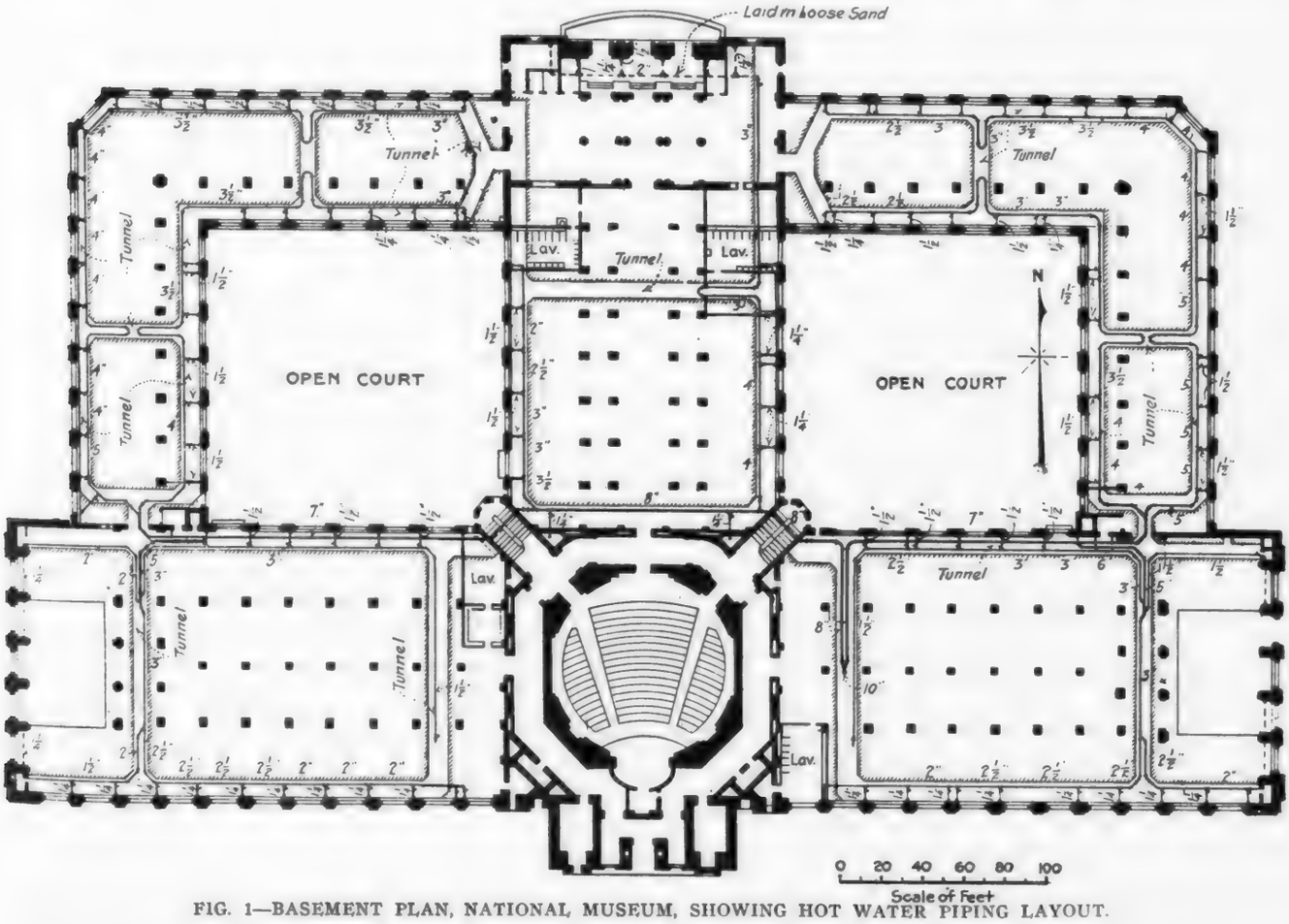


FIG. 1—BASEMENT PLAN, NATIONAL MUSEUM, SHOWING HOT WATER PIPING LAYOUT.

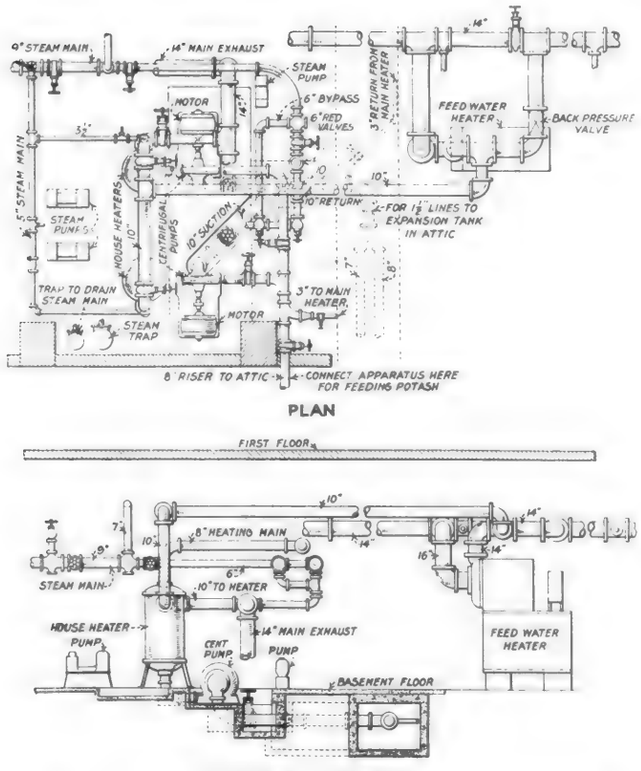


FIG. 2—DETAILS OF HOT WATER CONNECTIONS IN BASEMENT.

11,604,984 cu. ft., covering a total ground area, including two closed courts, of 168,752 sq. ft. The total floor area is 468,118 sq. ft.

The typical dimensions of each bay in the building is 18 ft. 6 in. There are three main skylights in each of the three wings, each being approximately 32 ft. wide by 149 ft. long, giving a total skylight surface of some 14,395 sq. ft. The grand total of exposed window and skylight area is 80,110 sq. ft., with more than half of it on the two main or exhibition floors.

A forced circulation hot water system is used to heat the building, volute pumps for this purpose being located in the engine room of the building. Hot water is supplied to 73,385 sq. ft. of direct radiation, together with 2480 sq. ft. of indirect radiation, partly for heating and ventilating the auditorium. Some of the radiators are 50 sections in length, with heating surfaces of more than 200 sq. ft. to take care of the large glass surfaces in the windows and the great volume of the halls. They are two and three columns, varying from 22 in. to 38 in. in height.

The circulation of the hot water is through a one-pipe system. An unusual feature is the manner in which the radiators are connected to a single pipe, there being two 1½ in. connections from the single drop, both of which are made at the same end of the radiator. There are 130 of these drops and are almost all of that size.

In order to provide sufficient water to each radiator, long-turn fittings were used and the connections to the drops made in a similar manner. The typical drop has connections to four radiators, one on each floor, the total heating surface ranging from 325 sq. ft. to 807 sq. ft.

From the heaters in the engine room an 8-in. riser runs directly to the attic from which there radiate the mains for distributing to the various parts of the build-

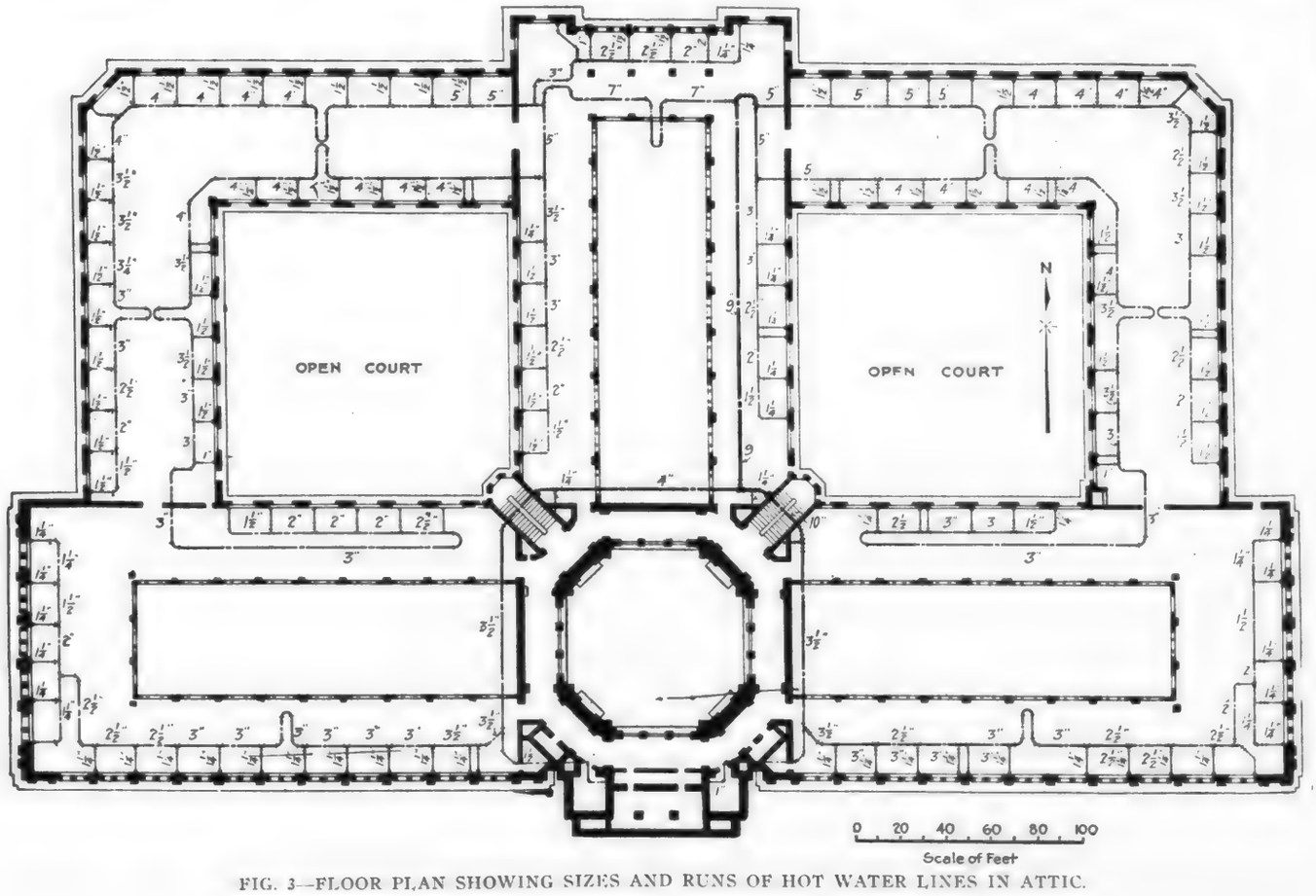


FIG. 3—FLOOR PLAN SHOWING SIZES AND RUNS OF HOT WATER LINES IN ATTIC.

ing. The great increase in size in the riser was made to allow a velocity of flow about twice as much as in the distributing mains. As the return mains in the tunnels were allowed the same drop, they have the same area as the attic mains. Automatic air traps of the Anderson type are used to.

The plant for heating the water, in the engine room, consists of two Alberger condensers, so designed that the water makes there complete passages through the

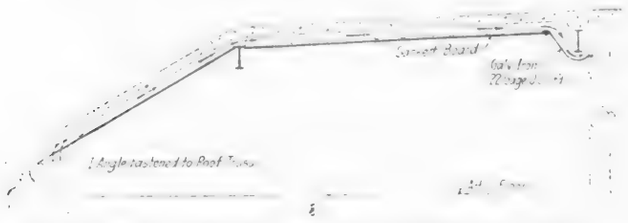


FIG. 4.—FALSE CEILING USED AS VENTILATING DUCT.

heater. The water in the heating system returns through the mains in the tunnels, finally reaching an 8-in. Alberger volute pump, directly connected to and driven by a 20-h. p. Westinghouse motor.

The speed of the pump can be regulated so as to pass a minimum of 70,000 gal. of water an hour and a maximum of 140,000 gal. This speed regulation was introduced to maintain the constant temperature difference between the incoming and outgoing water to the heater. The steam supply to the heater is connected with the main exhaust line in the engine room by a 10-in. pipe with the control valve and also with the high-pressure line by a 4-in. valve pipe. The exhaust line reaches the heater after passage of all exhaust steam through an open feed-water heater.

The manipulation of the several valves and the speed of the pump gives control of the temperature in the building to the operator in the engine room. The temperature of the discharge water from the heater is determined by the outdoor temperature by means of a temperature chart. This chart was originally determined to be a straight line, but has since been found incorrect for this particular building. This chart is based on a tem-

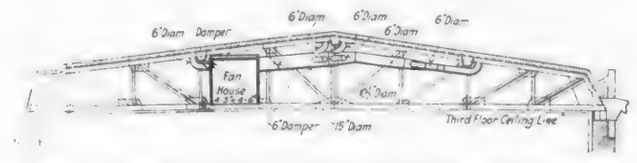


FIG. 5.—DETAIL OF FAN HOUSE AND DUCTS IN ATTIC.

perature difference of 10° between the supply and heater return. A curve has been established and is the one by which the operator regulates the temperature of the discharge from the heater.

No direct ventilating system is provided. In order, however, to assist the air movement a ventilating unit was placed in each of the outer ends of the three wings. These units remove the air directly from the skylight chambers above the wings and from the attic spaces above the ranges. The attic spaces are all connected directly to the floors below through chases in the outer walls together with certain openings provided directly from the ceilings of the rooms on the third floor. The air movement with the formation of a slight vacuum in the spaces mentioned, is through the openings from the floors below which, being entirely open, allows the removal of foul air from all portions of the building.

In the wing there is placed a false ceiling 5 inches below the underside of the roof, made up of ¼-in. Sacketts board, suspended from the ceiling, terminating about 5 ft. from the eaves of the roof and connected to the skylight spaces by means of a galvanized-iron bend which allows the passage of air underneath the roof girders which surround the skylight spaces. The treatment above the ranges performs the same duty, but is done in a different way owing to different conditions. This arrangement is also described in the paper.

A special ventilation system was provided for the auditorium. There are also special ventilating systems for some other services, such as removing foul air from each of the six large toilet rooms, and for supplying fresh air and removing warm air from engine and boiler rooms.

Heating and Ventilating the Bureau of Engraving and Printing

The description of this installation proved especially interesting as both the building and its mechanical equipment were designed by the Office of the Supervising Architect, Treasury Department. It was built in 1913. It houses one of the most interesting manufacturing plants in the country as in this building are turned out the paper money, postage stamps, etc., issued by the Federal government.

The building is comb-shaped, with the head house approximately 500 ft. long x 68 ft. wide. Four wings extend directly back from the head house, each wing being approximately 228 ft. long x 60 ft. wide, so that ample natural light and cross ventilation are assured. The total contents of the building measure 10,000,000 cu. ft., while the total glass area, set in metal window frames, measures 110,200 sq. ft., and the total wall area, exclusive of glass, is approximately 140,000 sq. ft., the wall having an average thickness of 18 in. It is constructed of brick, faced generally with limestone.

The building is heated by a total of 55,259 sq. ft. of direct cast-iron steam radiation which is connected on the two-pipe vacuum system. There is also installed ventilating equipment with indirect heating apparatus for operating a fan-blast system, but the system is designed essentially for heating by direct radiation.

It is the intent of the design to deliver all air for ventilation at 70° F., for which the equivalent of direct radiation installed is 66,000 sq. ft. approximately. There is, however, sufficient reserve indirect radiation installed to permit raising the temperature considerably higher than 70°, so that it may be used for heating the building in case of accident to the direct radiation system. The total equivalent direct radiation installed in the building is thus approximately 121,000 sq. ft.

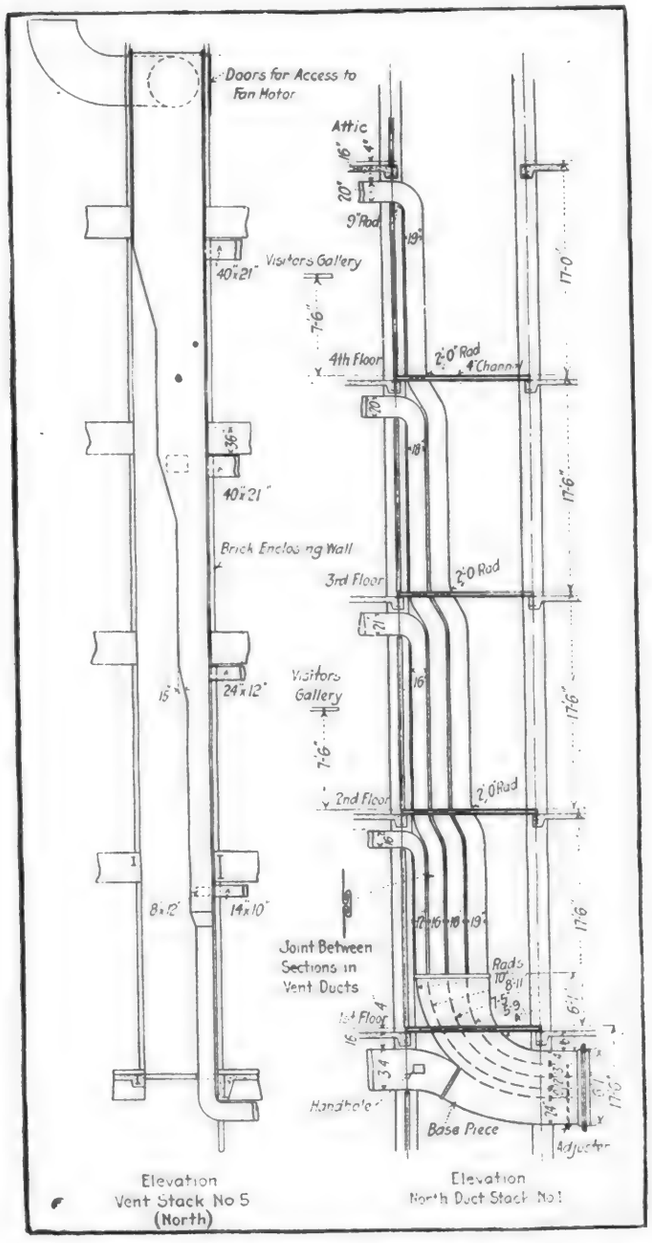
Steam for heating the building and for the various industrial processes involving the use of steam, such as drying the paper, etc., is generated in a separate power house, about 500 ft. distant, and is carried through a tunnel to the building where the pressure is reduced to 5 lbs. or less for heating and ventilating purposes.

Air is supplied by two plenum fans, each 102 in. in diameter, equipped with indirect heaters, air washers,

and duplicate steam engine and electric motor drives. The steam engine drives are operated in the heating system so that the exhaust steam may be utilized in the indirect heaters. At other times in the year, when heating is not required, the fans are driven by the electric motor.

Each fan is equipped with an indirect heating chamber which contains about 11,000 sq. ft. of heating surface, which is under thermostatic control so as to deliver air at a temperature of from 75° to 80° F. The fans discharge into vertical upcast ducts which are nested one duct for each floor. These ducts rise to the various floors, one branching at each floor into the ceiling distributing system.

The exhaust system for the building, which is operated through the locker rooms, is comprised of disc fans located on the roof of the building. Exhaust air passes from the main working rooms out through the locker rooms. In the locker rooms there are grilles opening into the vent flue, which flue serves as the enclosure through which the vertical upcast duct from the ventilating fans in the basement rises to the delivery outlets to the various floors.



BUREAU OF ENGRAVING AND PRINTING.
ARRANGEMENT OF AIR SUPPLY AND VENT DUCTS IN

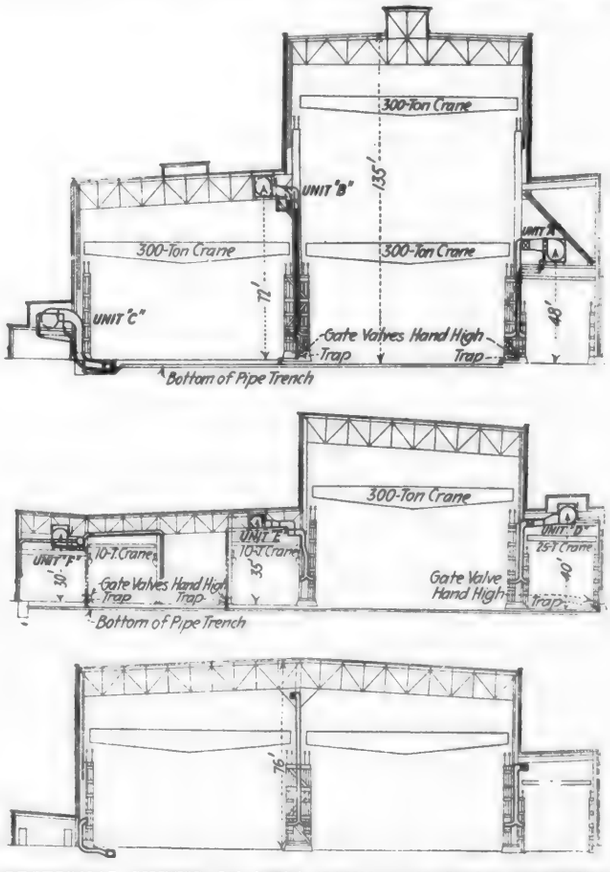
The interesting point was brought out that this installation, which was handled by the Thompson-Starrett Co., New York, was made under the direct supervision of William H. Driscoll, the new treasurer of the society.

Heating the New Navy Gun Shop

The new gun shop at the Washington Navy Yard is the largest of the six new buildings located in the west extension of the yard. The heating system was designed after details of the steel work had been completed by the contractors and it was then found that the clearances between columns were just sufficient to allow the largest guns to be passed when swung from cranes. Therefore no longitudinal air ducts could be run in the main aisles, and the cross aisles containing the gun lathes could not have ducts projecting into them. No space was available on the floor for heating units and no room between foundations for underground ducts in about 80% of the floor area.

A fan blast heating system was decided upon and the problem, therefore, was to heat a building 570 ft. long, 244 ft. wide, varying from 40 to 135 ft. in height by a fan blast system, using recirculated air, with the heating units from 30 to 72 ft. above the floor and with no space available for recirculating ducts and where no distributing ducts could be run in the aisles in either direction.

The problem was solved by locating six heating units in the roof spaces above the crane clearances, running



SECTIONAL VIEWS OF NEW NAVY GUN SHOP SHOWING VENTILATING UNITS.

distributing ducts in this same space and bringing the outlet branches down close to the columns.

Lack of space for heating apparatus of the required size and the impossibility of installing recirculating ducts from near the floor to the fan inlets was overcome by the use of high velocities at air outlets. The outlet velocity varies from 1000 to 1300 ft. per minute, with all outlets 10 ft. above the floor and delivering air horizontally.

Six fans and heater units produce and distribute heat for the building. Their location may be seen in the accompanying sectional views of the building. Since the inlet of Unit B is 72 ft. above the floor, no attempt was made to recirculate this air, the fresh air being admitted through a clerestory window. Unit C distributes air through a system of underground ducts which were possible at this part of the building.

All fans are motor-driven with remote push button control for stopping and starting motors from the floor of the shop. Volume dampers are installed in all outlets and deflectors in main ducts. No temperature control or speed control of fans is provided. Hand control of the Vento sections is relied upon for controlling the temperature of the room which was figured from 10° F. to 60° F.

The total capacity of the six fans is 223,000 cu. ft. per minute and the total Vento heating surface, 15,945 sq. ft. The total cubic contents of the building are 8,995,000 cu. ft. and figuring on an estimated heat loss of 16,735,000 B.T.U. the fans installed gave a 40-min. air change.

In discussing Mr. Cooley's paper, Mr. Carrier endorsed the practice of keeping the air outlets smaller than the pipes, in order to obtain the desired static pressure. This method, he said, has a wider application than is generally appreciated.

Morning Session, January 25.

So much matter was presented at this session at the Bureau of Standards that the meeting lasted all day. It was scheduled as a research session and included five important papers submitted by the Research Laboratory, as follows:

"Capacities of Steam Heating Risers as Affected by Critical Velocities of Steam and Condensate Mixtures," by F. C. Houghten and L. Ebin.

"The Physiological Reactions of Humans to High Temperatures and High Humidities," by Dr. W. J. McConnell and F. C. Houghten.

"Equal Comfort Lines for Still Air Conditions," by F. C. Houghten and P. C. Yagloglou.

"Methods of Determining Dust in Air," by S. H. Katz.

"The Anderson and Armspach Dust Determinator," by Margaret Ingels.

Capacities of Steam Heating Risers as Affected by Critical Velocity of Steam and Condensate Mixtures

THIS report was supplementary to one presented at the Society's Semi-Annual meeting last summer, and covered the items of (1) critical velocity of risers in one and two-pipe systems, (2) effect of rounded, reamed and unreamed entrances upon the critical velocity, (3) effect of entrances of pipe cut with single and three-wheel cutters upon the critical velocity and (4) effect of unions and couplings upon ths velocity.

After detailing the arrangement of the apparatus and method of procedure, charts were presented showing the various results including the following table which was characterized as containing much of the meat of the report. This table gives the capacity of the pipe in pounds of steam per hour, B. T. U. transmitted per hour, and square feet of radiation based on 240 B. T. U. per square foot.

CAPACITIES OF ONE-PIPE-STEAM RISERS

	Allowable Velocity in Feet per second					
	18			22		
Diam of Pipe in.	Cond lb hr	B t.u loss hr.	Sq. ft. Rad Based on 240 B t.u	Cond lb hr	B t.u loss hr	Sq. ft Rad Based on 240 B t.u
¾	8.9	8640	36.0	10.9	10580	44.1
1	14.5	14070	58.6	17.8	17270	72.0
1¼	25.2	24460	101.9	30.8	29890	124.5
1½	34.2	33190	138.1	41.8	40560	169.0
2	56.5	54830	228.4	69.0	66960	279.0

The following recommendations were incorporated in the report:

1. All pipe should be reamed.
2. Pipe with an unusually large bump, blister or other constriction on the inside should not be used. The capacity of a one-pipe system is no greater than the capacity of the free area left by its greatest constriction.
3. Unions and all other fittings entering into a riser should be of full-size opening.
4. The size of pipe for one-pipe risers carrying any quantity of steam should be determined in accordance with Column 1 of the table, or by Column 2 after applying the desired factor of safety.

Some Physiological Reactions to High Temperatures and Humidities

THIS paper is devoted to a study of the physiological effects of various temperatures and humidities on human subjects at rest in still air. All of the experiments reported were made with the temperature above 90° F.

The severity of the tests may be gauged from the statement that in some cases the body temperature of the men under test rose to 103° F. and the pulse rate to 162 pulsations per minute.

After describing the equipment and methods, Dr. McConnell presented the following conclusions:

1. There is an inability of the body at rest and in still air to compensate for saturated atmospheric conditions exceeding 90° F.
2. The physiological effects resulting from exposure to high temperatures and humidities depend upon both the wet and dry-bulb temperature readings.
3. The exhaustion and weakness following subjections of human beings to a very high temperature and humidity for a short period is not so severe as subjection to a moderately high temperature and humidity, but for a longer period.
4. The highest dry and wet-bulb temperatures attained and length of time endured in the experiments are as follows:

Dry-Bulb Temp. Deg. F.	Wet-Bulb Temp. Deg. F.	Relative Humidity, Per Cent.	Time, Minutes
112.5	112.5	100	35
120.2	104.02	60	40
147	108.4	30	45
157	100.43	15	45

5. The pulse rate, rather than the rise in body temperature, apparently determines the extent of the discomfort experienced by the subject. Subjects became very uncomfortable after the pulse-rate exceeded 135 pulsations per min., and complained of unbearable and distressing symptoms when the pulse exceeded 160 per min. The highest pulse rate recorded was 184 per min.

6. The systolic and diastolic blood pressure fell with moderate increase in temperature and humidity, and the systolic rose and the diastolic fell, thus increasing the pulse pressure, in high temperatures and humidities.

7. The curve of rectal temperature shows a close parallelism with the curve of the temperature of the test chamber at any constant humidity.

8. Subjection to high temperatures and humidities produced no marked change in the respiratory rate.

9. Loss of weight varies with the individual, the loss increasing with the length of exposure to high temperatures and with the severity of the test.

10. The haemoglobin content of the blood increases proportionately to the loss in weight.

11. An estimation of the changes in the sugar content of the blood proved negligible.

12. A relative increase in the blood count was found, but not an absolute one.

13. The rate of sweating varies with the atmospheric conditions. The loss of substances from the body through the sweat cannot be changed in their proportions to one another.

14. Examination of the urine was negative for albumen and sugar, and specific gravity increased.

15. The sweat is the chief factor in producing the irritation and inflammation of the eyes.

16. Ice water, even when large quantities were swallowed, did not cause cramps under the conditions of the experiments.

Determining Equal Comfort Lines

The sense of warmth experienced by the human body is not due alone to the temperature indicated by the dry-bulb thermometer, neither does it depend solely upon the wet-bulb temperature. Dry air at a relatively high temperature may feel cooler than air of considerably lower temperature with high moisture content.

Human comfort or discomfort depend entirely on body temperature and therefore on the relation between the rate of heat production and dissipation. By the process of metabolism heat is constantly generated within the body, while on the other hand, loss of heat is constantly occurring from the surface of the body by radiation, convection and evaporation. To maintain a constant body temperature the loss of heat must equal the heat produced. It is therefore apparent that any interference with the elimination of heat from the body is accompanied by a rise in temperature and a feeling of discomfort.

There are three principal factors affecting loss of body heat:

1. Temperature.
2. Humidity.
3. Air motion.

As the temperature of the air and surrounding objects rises, the loss of heat by convection and radiation decreases. When the temperature reaches that of the body, the loss by radiation and convection cease. Finally, as the air temperature exceeds that of the body, heat passes from the air to the body.

If, on the other hand, the relative humidity is increased the heat loss by evaporation decreases. If, while the dry-bulb temperature increases, the wet-bulb temperature decreases sufficiently, the increase in loss of heat by evaporation may be made equal to the decrease in loss of heat by radiation and convection, resulting in no change in body temperature or comfort.

From the above, it is concluded that there must necessarily exist certain combinations of temperatures and humidities, which will produce the same total body heat, loss by radiation, convection and evaporation and therefore the same feeling of comfort or discomfort. Lines passing through such air conditions may be called equal comfort lines. The fact is further substantiated by the general experience of heating engineers in observing that the lower the humidity the higher the temperature required for the same degree of comfort. The determination of these equal comfort lines for various temperatures, humidities and air velocities is the subject of one of the very important investigations being carried on at the Research Laboratory. The determination of these equal comfort lines for still air conditions is completed and the results are given in this paper.

The investigation of the effect of the various air velocities on the equal comfort lines is being continued at the laboratory and a report of this work will be rendered in a subsequent paper.

New Data on Air Dust Determinations

IN a clear-cut presentation, Miss Ingels showed slides of further developments of the Anderson and Armspach dust determinator, together with the results obtained in a series of tests. The apparatus itself was shown and it was pointed out that it can conveniently be used in field work. It is designed on the principle that there is a relation of the dust collected by a filter and the increase in resistance of the filter.

The tests described included those made with various kinds of cloth filters, using coal dust, silica and limestone and indicated the successful application of the dust determinator not in measuring the exact dustiness of the air but its relative dustiness.

Miss Ingels concluded her presentation with a demonstration of the machine.

In a discussion of the work of the Research Laboratory, an interesting point was brought up by Dean Anderson as to whether the laboratory should confine itself to its original purpose of establishing fundamentals or should go farther and define the requirements necessary. As he expressed it, the Research Laboratory was designed to give a basis of theory. He felt the Laboratory should always adhere to idealisms of theory but

that already the Laboratory is beginning to combine theory and practice and has reached conclusions on certain points, which, he felt, would stand. He felt that while it was necessary to adhere to theory, the Laboratory was in a position to analyze its conclusions from a practical viewpoint.

Mr. Mensing struck a popular note when he declared that a new system of definitions is needed in heating and ventilating work.

At the hour of twelve, Secretary of Commerce Herbert Hoover was ushered into the meeting by President elect H. P. Gant. Mr. Hoover was given an ovation which was repeated when President McColl formally introduced him.

SECRETARY HOOVER'S ADDRESS

Mr. Hoover spoke without notes, his theme being the elimination of waste. This, he said, was the most important of all the engineering problems of to-day. If we are to maintain our present standard of living, he said, we must devote ourselves to this work. Its engineering phases, he declared, are absolutely dominant.

He said he had just come from a conference on the so-called business cycle where the conclusion was reached that the question of stabilizing production and thus ironing out the peaks and valleys was distinctly up to the engineer, as plans and equipment go hand in hand with the consumption of goods.

We have two loads, he said producing and the corresponding expansion of plant requirements. We must defer expansion, he said, to periods of lessened demand for goods. The larger companies are making a practice of studying their expansion needs and are intentionally deferring 10% of such needs to times when unemployment prevails.

The economic problem is one for the engineering mind because the engineer deals quantitively with all questions, while the economist deals qualitatively. The problems of standardization and simplification are both directly connected with the elimination of waste.

We are facing a revolution in American industry, declared Mr. Hoover, and there has been more progress in the last two years in the direction indicated than in all the years previously.

The audience rose again as Mr. Hoover finished his address and took his leave. The regular order was then resumed.

In a formal report of the Committee on Research, Chairman Thornton Lewis stated that the increasing need of research in matters pertaining to heating and ventilating was positively amazing. He told of the agreement that had been reached with the American Institute of Architects, whereby the institute is providing funds for research work in connection with air leakage around windows. He also mentioned the cooperative work being done at the $50,000 laboratory of the Johnson Service Company in Milwaukee which had been made possible by President H. W. Ellis of that company.

Mr. Lewis paid a high tribute to the work accomplished by Director Anderson in bringing about practical results of the work carried on at the Research Laboratory and said that in addition to the papers presented, investigations were almost completed on the subjects of ozone and heat transmission. In connection with the last-named investigation he referred to the heat meter which has been designed by Percy Nicholls of the Research Laboratory staff, which he characterized as a notable contribution to science. Papers on these two subjects are now in preparation.

It was at this point that Mr. Lewis announced the approaching exhaustion of the research fund, adding that unless additional funds became available before February 1 the activities of the laboratory would have to be sharply curtailed.

When Dean Anderson arose to make his report he was warmly greeted. In establishing the Research Laboratory, he said, the society has taken a step in advance of any other scientific society in America. He referred enthusiastically to the ideal conditions prevailing at the Laboratory for conducting its work in promoting the health, comfort and happiness of mankind. There is a marked interest, he said, among all connected with the Bureau of Mines in Pittsburgh in the Research Laboratory, which is without question the heart of that institution, as far as enthusiasm is concerned.

"Everything," he said, "that we want is given to us, including mathematicians, photographers, computators and investigators, while the bureau's machinery and shops are at the laboratory's service." No laboratory, he declared, ever existed in a more wonderful atmosphere.

Heat, declared Dean Anderson, represents the basis of our existence. It pervades all life as energy. The comfort lines now being produced at the laboratory are monumental in the annals of science. While the present investigations in this connection are only for still air conditions, it is planned to extend them to determine the effect on subjects at rest and at work in both still air and moving air.

He compared the budget of the Research Laboratory, amounting to $27,000 a year, with the $3,000,000 fund appropriated by the General Electric Company and the $9,000,000 fund of the Western Electric Company and predicted that the time would come when the Research Laboratory would attract the attention of those capable of placing the Laboratory beyond the need of help for all time.

"Be a realist," he declared, "not an optimist or a pessimist," a sentiment which caught the fancy of his hearers in an unmistakable manner.

Afternoon Session, January 25.

With the report of Chairman Thornton Lewis and the address of Dean Anderson, the stage was set for the drive for funds for the Research Laboratory, which was taken up at the opening of the afternoon session. The result, as stated, was the addition of subscriptions totalling $9,367 which will enable the work to proceed as planned and even be extended.

The remainder of the session was devoted to the Research Laboratory papers.

Morning Session, January 26.

Friday morning's session, which was held at the Hotel Washington, opened with the presentation of a paper on "Humidity Requirements for Residences," by A. P. Kratz.

The remainder of the session was devoted to warm-air furnace heating, this subject being introduced in a paper by F. T. Giblin and Frank K. Chew on "Some Comments on Warm-Air Furnace Installation."

Some Comments on Furnace Installation

This paper proved a timely contribution to the discussion of the new Warm-Air Furnace Code which was adopted by a number of furnace associations but not approved by the A. S. H. & V. E., in furnishing a comparison between the pipe sizes figured by the code and those figured by the rules advanced in a paper by M. William Ehrlich and those recommended by Professor A. C. Willard of the University of Illinois. The installation under discussion was that of some 800 standard all-cast-iron warm-air furnaces of the Giblin type in as many houses built by one of the large steel companies in a Pennsylvania town. These houses were built in 1917.

The pipe sizes actually used which, it was stated, have given satisfactory results, compared very closely with those indicated by the Ehrlich and Willard rules and were generally smaller than would be obtained by following the code rules, using either the much-discussed "8 factor" or "9 factor." In the discussion which has centered around the code rules, the "9 factor" has been recommended by many as giving a more desirable register temperature of 175° F., while the "8 factor" was based on a register temperature of 195°, which was held to be too high. Professor Willard, who has strongly advocated the 175° basis, has also held that the requirements for first floor rooms should be determined by dividing the heat unit requirements by 100, which gives larger first-floor pipe sizes than the Ehrlich rule, but not large than if figured by the code rule using either the "8" or "9" factor.

The total cross-sectional pipe area actually used in each house was 556 sq. ft. for the first floor and 252 sq. ft. for the second floor. By the Ehrlich rules, the required area came to 529 sq. ft. for the first floor and 191 sq. ft. for the second floor. The Willard rules gave 595 sq. ft. for the first floor and 191 sq. ft. for the second floor. According to the code rules using the "8 factor," the first-floor area totaled 618 sq. ft. and, with the "9 factor," 669 sq. ft., while the second-floor area came to 150 sq. ft.

The report was then presented of the Committee on Code for Installation of a Warm-Air Furnace and this aroused a lengthy discussion which was entered into by P. J. Dougherty, F. R. Still and Messrs. Small, Williams and Langenberg.

Changes in Warm-Air Furnace Code Proposed by S. H. & V. E.

The changes and recommendations proposed by the American Society of Heating and Ventilating Engineers in the Warm-Air Furnace Code referred principally to Section 1 where the use of the factor "9" is recommended, based on an air temperature of 175° at the register, instead of the factor "8," which contemplates an air temperature at the register of 195°. In Section 3, the requirement proposed is that risers have an equal area equal to 80% of the leader area, instead of 60% in the code, and providing that all risers have a depth of at least 4½ in.

Another change is in Section 5 giving a method of determining furnace capacity with the recommendation that the code method be used only for comparison or to check up the findings. The proposed new matter for Section 5 reads as follows:

Section 5. Size of Furnace—Method No. 1: (Square foot exposed glass × 80) + [(Square foot exposed wall — glass) × 25)] + (Cubic foot room volume × 1.25) = Heat loss in British thermal units (B. T. U.) from the room per hour. Add together the heat losses for all the rooms and the result will be the heat loss *H* for the house. For coal of 12,000 B. T. U. per pound, which may be taken as a safe value, we have

$$\text{Area of Furnace Grate in square inches} = \frac{1441H}{36{,}000} = 0.0041H$$

Select a furnace having a grate area of at least this amount.

Method No. 2—(Check for Method No. 1): Add together the actual warm-air leader areas in square inches, as obtained in Section 1, and select a furnace having a free area of not less than the sum of all the leader areas.

On motion of Mr. Still, a resolution was adopted to approve the code submitted as a preliminary draft and to continue the committee to complete its work on the basis of adopting the factor 9, instead of 8, for the first story leaders in residences.

Mr. Langenberg stated that 100,000 copies of the code as adopted by the other organizations interested had been issued, one being sent to every prospect and one placed in every barrel of repair parts sent out. He said that from 500,000 to 1,000,000 additional copies would be sent out in the near future and suggested that the resolution adopted by the society might be printed in the new edition. This suggestion was adopted by the society.

The presence of W. Nelson Haden, a former president of the (British) Institution of Heating and Ventilating Engineers, was noted by President McColl and Mr. Haden responded by telling of the state of the art of heating and ventilating in England. He mentioned, among other things, the use of glass eliminator plates in connection with air washers in England. He emphasized the fact that the predominance of water heating systems in England and steam heating systems in America was due to the different temperature conditions in the two countries. In England it is customary to figure on a 30° to 60° rise, as compared with zero to 70° in this country.

Mr. Haden's son, who was present, also spoke, stating that he was studying district heating conditions in this country with the Detroit Edison Company. He felt that many sections of England could be well served by district heating plants.

Before luncheon the proposed revision of the society's constitution was taken up and the discussion extended late into the afternoon session.

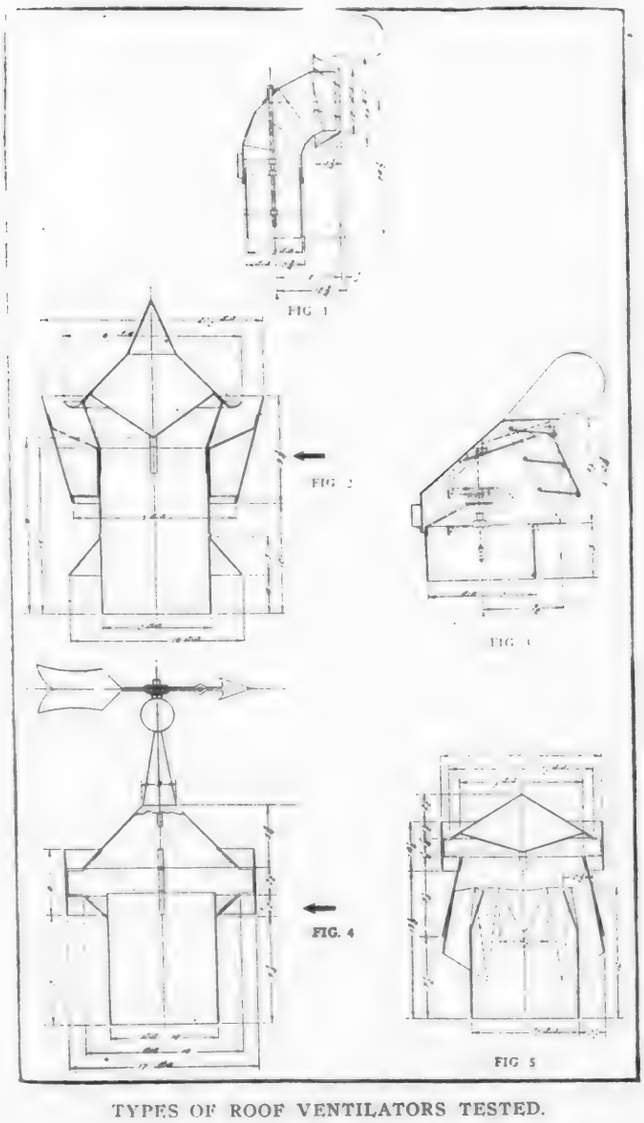
Final Session, January 26.

By the time the revision of the constitution had been completed there was little opportunity for the discussion of the remaining papers on the program. These included "Modern Tendencies of Ventilation Practice," by Dr. George T. Palmer; "Comparative Tests of Roof Ventilators," by Professor F. B. Rowley; and "Wind Tunnel Tests of Roof Ventilators," by H. L. Dryden.

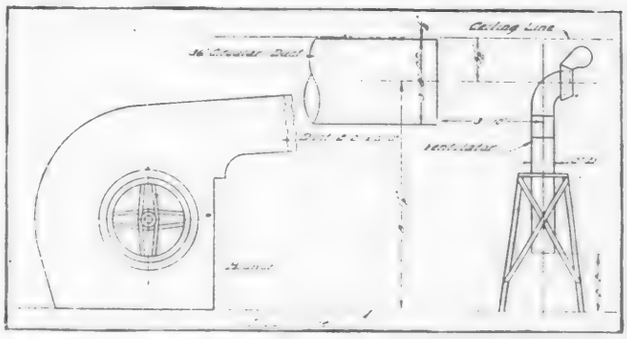
Comparative Tests of Roof Ventilators

In this paper a report was presented of tests of five distinct types of automatic ventilators, the data supplementing very nicely the paper of Dryden, Stutz and Head, presented at the Philadelphia meeting of the society in 1921 and the papers of Professor A. J. Mack and C. J. Bradley (published in THE HEATING AND VENTILATING MAGAZINE for October, 1920 and April, 1922).

All of the ventilators used in this particular test were 10 in. in diameter and were mounted as shown in the accompanying illustration. The wind velocity was produced by a No. 8 double-inlet Sirocco fan, discharging through a 36-in. circular duct. The ventilators were



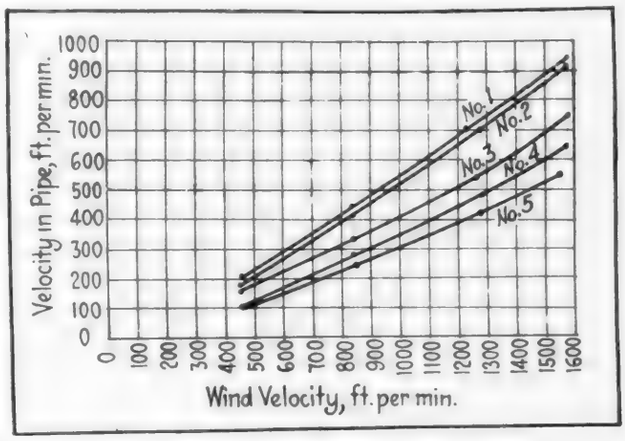
TYPES OF ROOF VENTILATORS TESTED.



ARRANGEMENT OF APPARATUS FOR TESTING ROOF VENTILATORS.

placed 3 ft. 10 in. in front of the outlet and in such a position that the center-line of the head was as near as possible in the center-line of the duct. The ventilator pipe was supported in a frame, the bottom of the pipe being approximately 2 ft. from the floor line.

In comparing the results of these tests with those made by Professor Calderwood, Mack and Bradley, it



RESULTS OF ROOF VENTILATOR TESTS.

will be seen that ventilator No. 1 corresponds to those classified by them as the rotary siphoning type. The results obtained in both series of tests, as shown by the curves, corresponds very closely. No. 4 of this test corresponds to the plain stationary ventilator, and No. 5 of the stationary siphoning of the former tests. The results in these two cases are inverted, that is, the plain stationary ventilator gives greater efficiency in these tests while the stationary siphoning gives the highest efficiency in the Calderwood-Mack-Bradley tests at the Kansas Agricultural College. This, it is explained, may be accounted for by the different dimensions of the ventilators used.

Ventilator No. 2 in these tests would, no doubt, be classified in the former tests as plain stationary; yet this ventilator showed efficiencies which are very close to the best ventilators in either set of tests. The plain stationary ventilators in the former tests show the lowest efficiencies.

The authors conclude that it would appear to be impossible to take ventilators of the same class and expect uniform results, but that ventilators, even though smaller and classified as the same, will give entirely different results depending upon the dimensions and proportions.

Modern Tendencies of Ventilating Practice

Dr. Palmer first traced the various theories which have prevailed during the last half century as to the effects of vitiated air, showing how the conceptions of ventilation have changed during that time. He dwelt at length on what he termed "the carbon dioxide bogey" and also told of the rise and fall of the theory of "organic effluvial poison." Dr. Palmer then told of the increased attention given temperature and moisture beginning about 1895 and outlined the increasing respect that has been shown during the last twenty years to the thermal factors of the atmosphere, with a corresponding diminishing importance attached to the chemical constituents.

Speaking of recirculation, Dr. Palmer took the position that where the cubic space is great, this is an entirely feasible plan, for natural leakage through walls and around doors and windows is sufficient to prevent any unusual accumulation of odorous material in the air. This method has much to commend it in places where the air space is ample and the vitiating factors—from human beings, illuminating gases and industrial processes—are relatively slight.

Commenting on the various state and other laws, most of which provide for 30 cu. ft. of "fresh" air per minute per occupant, Dr. Palmer declared that it is entirely feasible to maintain good ventilation in such places as school rooms when equipped with:

a. Direct radiation.
b. Window deflectors.
c. Spacious gravity exhaust ducts on the inside wall.
d. Readily adjustable windows.
e. Readily adjustable temperature control, automatic or hand.

This type of ventilation, he added, shows from the experience of the New York State Commission on Ventilation great promise in providing cool atmospheres, with fluctuating air movement, free from offensive odors and large amounts of dust. And yet, under the above rules and regulations this method is completely ruled out because of the positive air flow requirements of 30 cu. ft. per minute which can be produced only by mechanical means. Recirculation likewise is rendered impossible by many of these laws and regulations.

Dr. Palmer stated that there is a uniformity of opinion on certain fundamental ventilation requirements which we may group as follows:

1. Except in rooms occupied by a few persons only, ventilation solely by means of windows located on one wall of a building is unsatisfactory. Consequently a schoolroom with window exposure on one side only and without exhaust ducts cannot be ventilated in a satisfactory manner.

2. Assembly rooms, audience halls, theatres, court rooms and other places where people congregate in such large numbers that the floor space per person is not more than 10 sq. ft. cannot be satisfactorily ventilated during the heating season except by means of mechanically-propelled air.

CONVENTION PHOTOGRAPH OF AMERICAN SOCIETY OF HEATING AND VENTIL

3. During the summer time moving picture theatres and other places where people congregate to a similar extent demand mechanically-propelled air for comfort. This may be accomplished by numerous circulating fans distributed at various points or by blower fans sending cool air through the enclosure or by a combination of the two. The cooling of the air is done in various ways—by means of an air washer, ice or brine coils.

As to the ventilation of schoolrooms there exists a divided opinion. As already stated, the work of the New York Commission indicates certain undeveloped and hitherto unrecognized advantages of window ventilation with gravity exhaust. There is no question that the statutes regarding air flow for this type of room should be altered so as to permit the use of window ventilation.

Under "Meeting the Present-Day Ventilation Needs," Dr. Palmer held that, aside from the special ventilation problems of industry, involving dust and fumes removal, the greatest need today in homes, offices, schools, barracks, prisons and hospitals is for facilities for maintaining a proper temperature range. This, he added, means easily adjustable windows, window deflectors, direct radiation, ready control of heating unit either automatically or by hand, and, where it is impossible to secure cross ventilation by windows, there should be a provision for exhaust ducts with dampers near the interior of the room. It must be the aim of the engineer and the architect to provide people with the means to keep comfortably cool. We have had enough of the overheated radiator which cannot be turned off, the traversing of an occupied room by uninsulated steam pipes whose heat it is impracticable to cut off, the window which will not budge. More attention must be paid to these details in order to improve indoor air comfort in the less crowded inclosures.

In schools which are mechanically ventilated we discard the 30 cu. ft. standard and also give up the idea that it is necessary to send air to every point in the room. The extremists in 1870 wished to flush a room as a body of policemen would clear a hall, pushing all before them. This was ventilation by displacement. We now ventilate by dilution. It would seem that still better results could be accomplished in schools and auditoria by substituting surface skimming in place of flushing. We must also substitute the intermittent or ejector type of air flow for the monotonous uniformity which now characterizes mechanical ventilation. This will mean changing the inlet register from its accustomed place on the inner wall to the space between the direct radiation and the outer wall. The course of air flow will be upward across the upper levels of the rooms and down the inner wall to the outlet. Windows may then be opened with impunity, the mechanical air flow creating an aspiring effect which will draw in the cold outside air and send it over the room.

Included in the types of buildings where recirculated air could be used, Dr. Palmer mentioned gymnasia, churches, large assembly halls and sparsely-occupied stores and factories.

The meeting concluded with the installation of the new president, H. P. Gant, and the other new officers, councilmen and members of the Committee on Research.

RS, TAKEN AT BUREAU OF STANDARDS, WASHINGTON, D. C., JANUARY 25, 1923.

Washington Proves Ideal Convention City

It is safe to say that every expectation of the visiting members and guests was more than fulfilled by the hospitality extended by the Capital City. As usual, the crowning social event was the society's annual banquet at the Hotel Washington on Thursday evening, January 25. For this occasion, the local committee had spared no effort and to say that the dinner was a brilliant success hardly does it justice. Nearly 300 covers were necessary to accommodate the guests.

William Knowles Cooper, president of the Washington Rotary Club, acted as toastmaster and the principal speaker was Major-General John A. Lejeune, commandant of the U. S. Marine Corps, who inspired his hearers with accounts of the part the Marine Corps played in France during the World War. W. Nelson Haden, a former president of the (British) Institution of Heating and Ventilating Engineers, responded to the toastmaster's introduction by expressing his pleasure in being present and his astonishment in noting the thirst for knowledge which seemed to pervade the technical sessions.

A suprise was sprung on President-elect H. P. Gant when John D. Cassell, of Philadelphia, in a happy address, presented him with a basket of roses on behalf of the Philadelphia members, as a token of their esteem and good wishes. Mr. Gant responded gracefully, the assemblage rising to him as he concluded.

A novel feature of the singing between the courses was the fact that it was directed by Robert Lawrence, director of the Community Music Association of Washington.

Following the dinner, the floor was cleared for dancing.

The host of attractions in Washington made it easy to arrange the ladies' entertainment program. Among the scheduled trips was one to the Lee Mansion and the Amphitheatre in Arlington Cemetery, taking in also the Lincoln Memorial.

Much regret was expressed that owing to illness, President Harding was not able to receive the members and guests at the White House, as scheduled, on the afternoon of January 25.

For the general committee, Chairman Charles V. Haynes came in for many congratulations on the prominent part he played in making the entertainment fea-

K. YAMASAKI, OF TOKIO, JAPAN, WHO ATTENDED THE HEATING ENGINEERS' CONVENTION.

PAST PRESIDENT W. NELSON HADEN OF THE (BRITISH) INSTITUTION OF HEATING AND VENTILATING ENGINEERS.

HUDSON MAXIM, WHO WAS A GUEST AT THE CONVENTION, IN COMPANY WITH MRS. MAXIM (LEFT) AND MRS. ARTHUR A. KIEWITZ.

A. S. H. & V. E. DINNER AT THE HOTEL WASHINGTON, WASHINGTON, D. C., JANUARY 25, 1923.

tures such a pronounced success. In addition to Mr. Haynes the committee included C. R. Bradbury, vice-chairman; M. S. Cooley, treasurer; and Herbert Coward, secretary. The sub-committee chairmen were: Finance, H. C. Russell; Hotel and Banquet, W. W. Towson; ladies' entertainment, E. L. Stock; meetings, Nelson S. Thompson; Press, E. L. Stock; Registration, W. W. Towson and Transportation, Herbert Coward.

Plans for the 1923 Guide.

In a prospectus of the A. S. H. & V. E. 1923 Guide, which has been issued by the Guide Publication Committee, A. S. H. & V. E., through Chairman Esten Bolling, the point is emphasized that the Guide was established to further the development of the industry and profession by promoting the use of modern heating and ventilating equipment, and by providing architects, engineers and contractors with an adequate and authoritative reference guide to such equipment. Full information is given as to rates and copy for manufacturers' announcements, together with duplicate order forms and typical pages from the catalogue data section.

The new edition will follow in general the plan of the 1922 edition. The first three sections will be devoted to (1) society standards, committee reports and technical papers from the society's Transactions; (2) general engineering data; and (3) modern engineering and equipment practice in which examples will be shown of representative installations; and (4) catalogue data of manufacturers. The rates for space in the new Guide are the same as last year, $100.00 for the first page and $80.00 for each additional page.

Charter Granted to Wisconsin Chapter.

Permanent organization of the Wisconsin Chapter has been effected by the election of the following officers at a meeting held in Milwaukee, January 12: President, Charles W. Miller; vice-president, Frank E. Downey; treasurer, Fred G. Weimer; secretary, Edward J. Lomasney. Board of governors: Edmund Grassler, H. L. Williams and John H. Best.

Residence Heating Problems Discussed by Philadelphia Chapter.

Charles Binder of Warren Webster & Co., and John M. Sewall of the Haynes Selling Company, were the principal speakers at the January meeting of the Philadelphia Chapter, held at the Engineers' Club, January 11. Mr. Binder's subject was "Vapor Heating for a Residence," and was illustrated by lantern slides. Numerous questions were asked the speaker by various members and several told of their experiences with systems of this kind. Mr. Sewall described a typical one-pipe steam system for a residence. Blue prints were distributed of the building showing the layout of the radiators and piping and the details of the design were explained and discussed.

Mensing & Company were the lucky winners of the sedan which was drawn for at the meeting. After all the coupons had been placed in a bowl and thoroughly mixed, Mr. Hale, chairman of the committee, announced that the tenth ticket drawn would be the winning number. This ticket was No. 4583, held by Mensing & Company.

Vehicular Tunnel Ventilation Discussed by Illinois Chapter.

Professor A. C. Willard of the University of Illinois spoke on "University of Illinois Ventilation Investigation for the Hudson River Vehicular Tunnel" before the Illinois Chapter at its January meeting, at the Chicago Engineers' Club, January 15. Professor Willard told of the procedure followed at the university in the effort to solve the problems connected with the ventilation of this type of tunnel. He stated that the Engineering Experiment Station of the University of Illinois will shortly publish a report covering all the formulas and essential data worked out by Professor Willard. The report, he said, will be generally available.

In the business session preceding Professor Willard's address, a resolution was adopted, moved by H. M. Hart, that the American Society of Heating and Ventilating Engineers be invited to hold its next semi-annual meeting in Chicago.

Vice-President Linn, who occupied the chair in the absence of President Nelson, announced that the subject for the February meeting would be "Discussion of the Rules for Figuring Radiation and Boiler Sizes, as adopted by the Chicago Master Steam Fitters' Association." The subject will be introduced by Charles D. Allan. It was voted to invite the Illinois Society of Architects to attend this meeting.

New York Chapter's "Trouble" Meeting.

Members and guests of the New York Chapter who came primed for "trouble" at its January meeting, at the Building Trades Club, January 22, saw their troubles vanish as the committee in charge, headed by James A. Donnelly, unfolded the program. The meeting was announced as a pre-convention meeting, for the entertainment of visiting members en route to Washington. After keeping the diners in suspense for a sufficient period, Mr. Donnelly announced various "trouble men" who turned out to be singularly accomplished in the musical line. In short, the outcome of the speechmaking was a delightful program of professional entertainment which included a magician as well as a number of capable singers.

At the conclusion of this part of the program A. R. Gibbons of Johns-Manville, Inc., showed moving pictures of "The Mining of Asbestos and its Manufacture," which proved both instructive and entertaining.

Among the out-of-town guests present were President Jay R. McColl, of Detroit, who told of his experiences in England last summer, and Mr. and Mrs. Walter E. Gillham of the Kansas City Chapter.

At the conclusion of the evening Mr. Donnelly came in for many congratulations on the success of his innovations.

Many comments were heard also on the presence of the ladies. They had been especially invited for the occasion. The opinion was expressed by more than one that the chapter would benefit from their presence at future meetings at least for the dinner itself. It would then be easy to arrange a theatre party for them, and the meeting would be over in time for the men to meet them and accompany them home.

Address on Ozone Before St. Louis Chapter.

Dr. F. O. Anderegg, professor of chemistry at Purdue University, was the principal speaker at the January meeting of the St. Louis Chapter, his subject being "Ozone." Dr. Anderegg graphically illustrated the formation of O_3 by the rearrangement of the atoms and electrons. He described some preliminary experiments with mice, showing the value of O_3 as a restorative from suffocation from foul air, if applied in time. Dr. Anderegg also showed that there is practicall no danger from nitrous gases, provided the concentration is kept down. The ideal concentration, he said, is about one part of O_3 to 10,000,000 parts of air, or enough to make it barely perceptible to the nose. At this concentration the nitrous gases would amount to 60 to 1, or 1 to 600,000,000 parts of air. This, be added, is not likely to be exceeded if the voltage is kept below 5,000 volts. As a rule, 2500 volts are found satisfactory.

Dr. Anderegg stated that he is still engaged in research work on this general subject, his particular investigation at present being on the effect of O_3 on sulphur and carbon.

In response to a question as to whether O_3 would be of any benefit in connection with the ventilation of the Hudson River vehicular tunnel, where air under pressure is to be introduced at the level of the exhaust pipes of the automobiles to dilute the CO produced, Dr. Anderegg replied that by itself O_3 would be of little or no value, owing to the difficulty of diluting CO.

E. S. Hallett spoke of the benefits secured in the 43 schools in St. Louis at present equipped with ozone apparatus. He spoke particularly of one school in the packing house district where the teachers have trouble in getting the children to go outdoors during the recess period. The odors in the outdoor air are rather sickening, but these he said are neutralized within the building through the use of ozone.

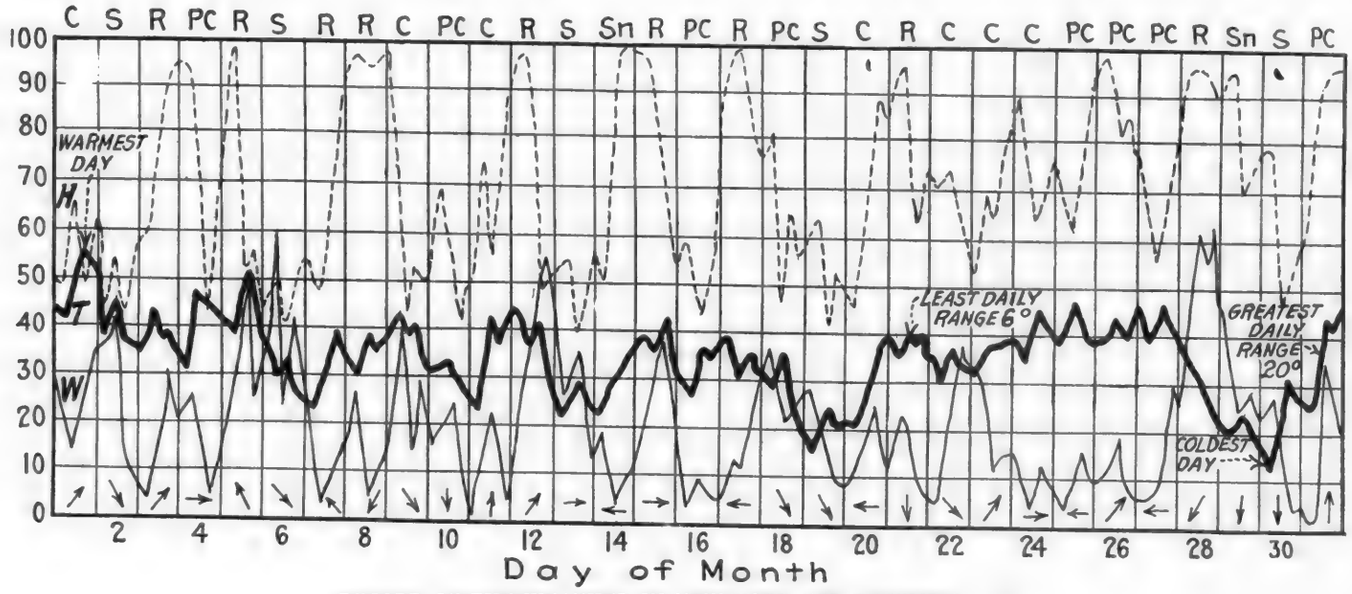
Kansas City Chapter Told of Ventilating Requirements of Hudson River Tunnel.

Professor A. C. Willard, head of the mechanical engineering department of the University of Illinois, was the principal speaker at the January meeting of the Kansas City Chapter, held at the Kansas City Club, January 8. Professor Willard's subject was "Ventilation Investigation of the Hudson River Vehicular Tunnel." He gave an interesting review of the research work at the University which was carried out in connection with a study of the ventilation problem in this tunnel. Professor Willard characterized the problem as the largest of its kind ever put before American heating engineers.

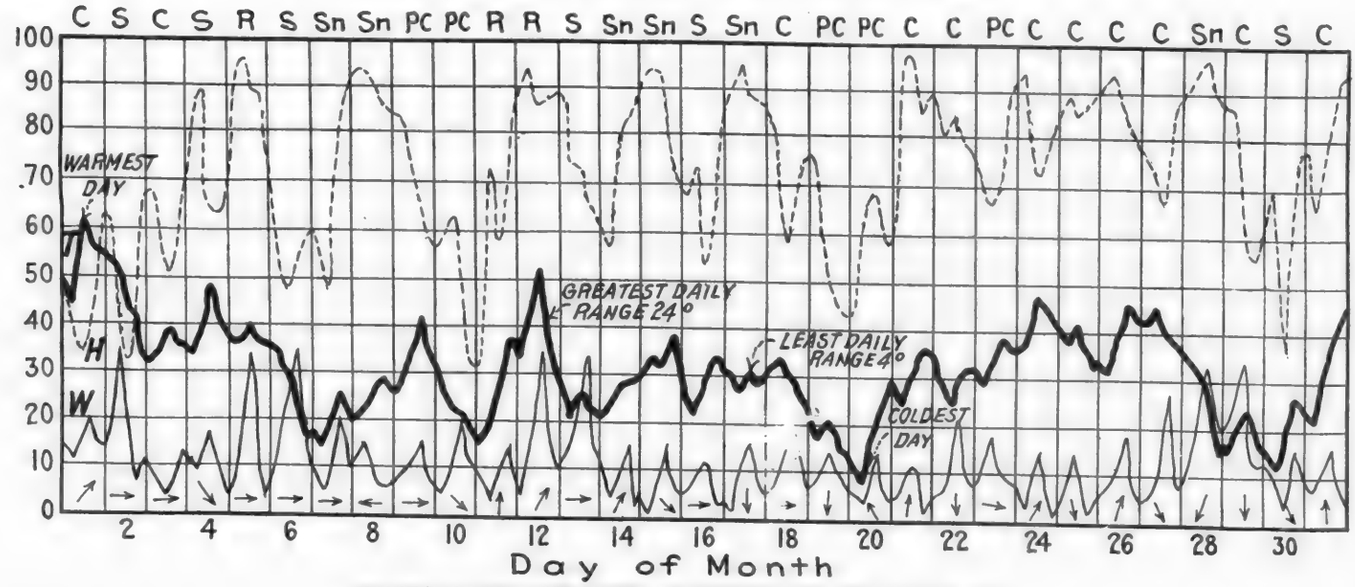
N. W. Downes was chairman for the evening.

The Weather for December, 1922

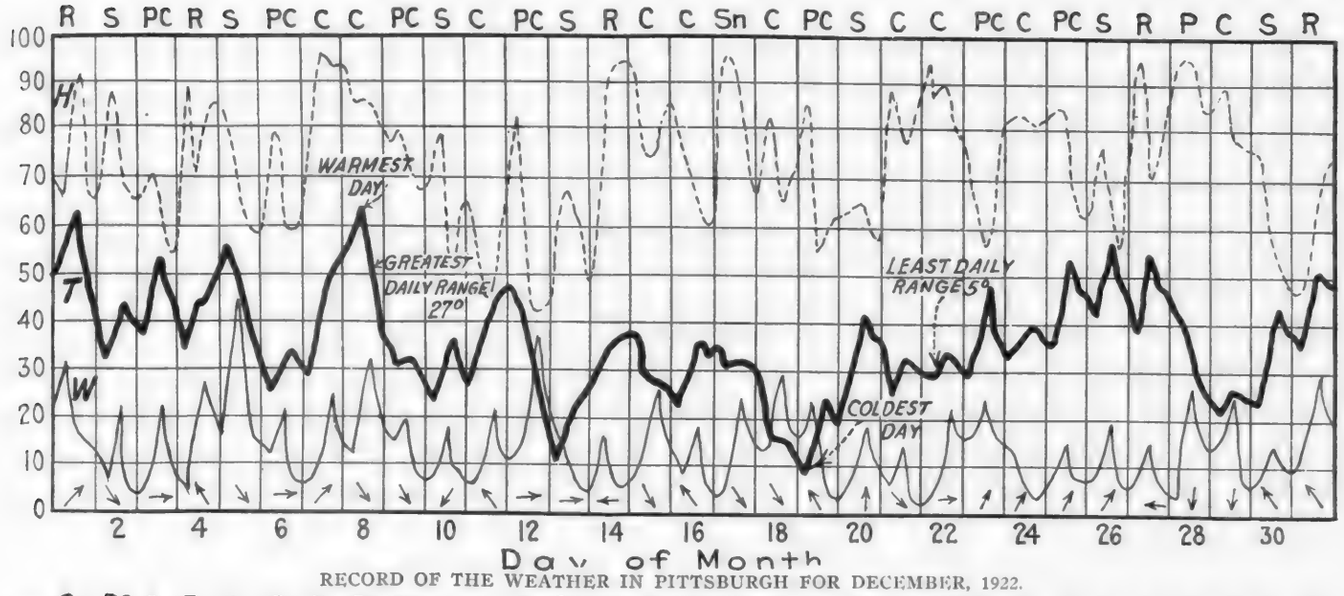
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, deg. F.	56	61	64	58	67
Date of same	1	1	8	1	4
Lowest temperature, deg. F.	13	8	9	—3	5
Date of same	30	20	19	18	18
Greatest daily range, deg. F.	20	24	27	35	37
Date of same	31	12	8	8	8
Least daily range, deg. F.	6	4	5	4	8
Date of same	21	17	22	28	36.7
Mean temp. for month, deg. F.	34.3	30.9	35.6	29.9	34.8
Normal mean for month, deg. F.	34.4	31.8	34.2	30.0	4.98
Total precipitation, inches	3.29	3.01	1.98	1.21	0.5
Total snowfall, inches	6.0	14.7	2.1	2.4	2.23
Normal precip. for month, in.	3.45	3.41	2.73	2.07	9,895
Total wind for month, miles	11,408	7,852	8,144	9,470	S.
Prevailing direction	N. W.	W.	W.	W.	10
Number of clear days	5	7	5	8	11
Number of partly cloudy days	10	6	5	6	10
Number of cloudy days	16	18	21	17	8
Number days with precipitation	12	9	12	10	2
Number of days with snow	5	8	2	4	0
Snow on ground at end of month, in.	0.8	4.0	0	0	



RECORD OF THE WEATHER IN NEW YORK FOR DECEMBER, 1922.
(Hourly Observations of the Relative Humidity Plotted on this Chart.



RECORD OF THE WEATHER IN BOSTON FOR DECEMBER, 1922.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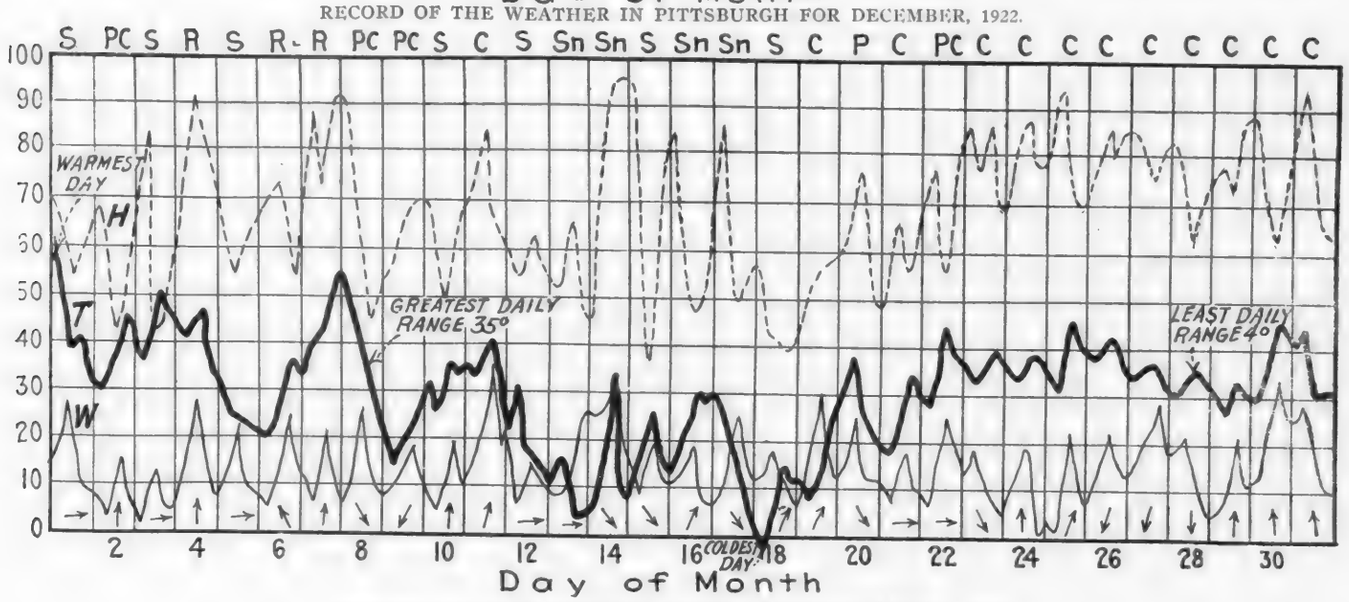
LEAST DAILY RANGE 5°
COLDEST DAY
Day of Month

RECORD OF THE WEATHER IN PITTSBURGH FOR DECEMBER, 1922.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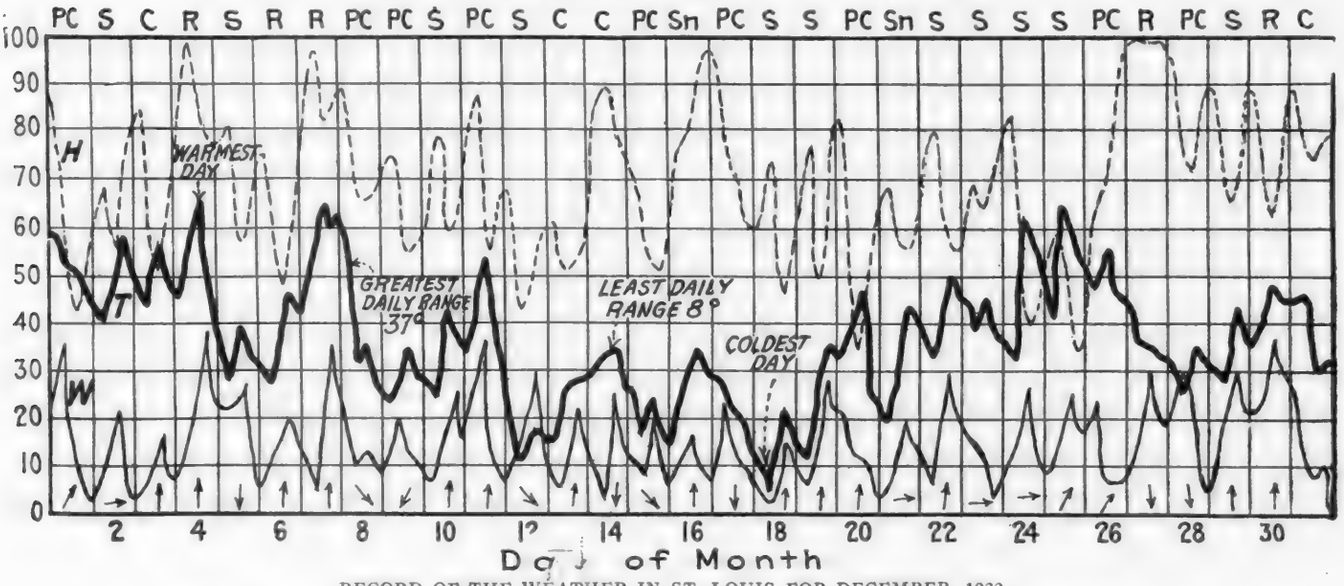
LEAST DAILY RANGE 4°
COLDEST DAY
Day of Month

RECORD OF THE WEATHER IN CHICAGO FOR DECEMBER, 1922.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WARMEST DAY
GREATEST DAILY RANGE 37°
LEAST DAILY RANGE 8°
COLDEST DAY
Day of Month

RECORD OF THE WEATHER IN ST. LOUIS FOR DECEMBER, 1922.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F.
Light lines indicate wind in miles per hour.
Broken lines indicate humidity in percentage from readings taken at 8 A. M., 12 M., and 8 P. M.
S—Clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.
Arrows fly with prevailing directions of wind.

Correspondence

Is There Any Saving In Vacuum Steam Heating?

EDITOR HEATING AND VENTILATING MAGAZINE:

In the December issue of your magazine, on Page 64, Inquirer, in closing his article under the heading, "Is There Any Saving in Vacuum Heating?" says:

"But will someone explain how steam can be generated and circulated under 10 in. or any other degree of vacuum when it is generally understood that steam breaks a vacuum, instead of making one?"

Inquirer seems to have been having a vigorous discussion with some vacuum-vapor heating salesman whom he quotes as making the "flat statement that with his specialties installed the owner could save 20% of the coal required by any similar or good-working vapor heating plant."

Without any desire to even seem to indorse the "heating salesman's" rather extravagant claim, which he would probably have considerable difficulty to demonstrate for any considerable running time (although it is possible that in an entire season's run some saving might be shown, if a very accurate test were made), it seems to me to be important to try to help Inquirer to a fair understanding of the question which bothers him. To aid Inquirer in his investigation, it seems necessary to get his young man "who is handy at figuring," to begin figuring the problem from the correct starting point to the 10-lbs. gauge pressure discussed by Inquirer. When this has been accomplished, it would be interesting to listen to the next discussion between Inquirer and the so-called vacuum heating system man. As, without doubt, there are many of your readers who are also perplexed over this same question, I will, with your permission, endeavor to make clear, to some extent at least, the principles bearing on this problem.

If Inquirer will look at any complete table of the properties of saturated steam and start with the Fahrenheit temperature of 32°, or the freezing point of water, he will find the proper starting point for the discussion. A full explanation of the question he raises will be found, I trust, by the time his handy young man has completed checking the figures I shall quote.

The weight of pure air at sea level produces a pressure of 14.6963 lbs. per square inch of surface. The weight or pressure is exactly balanced by a column of pure mercury 29.92 in. high. These are usually referred to as 14.7 lbs. air pressure and 30 in. mercury.

The next thing to note is that water at 32° F. gives off no heat to the surrounding air at 32° F. while the barometer shows an entire lack of atmospheric pressure. In other words, a vacuum equal to 14.6963 lbs. per square inch has been obtained so far as the water is concerned. Now, if the water in a heating boiler is heated to the boiling point while air pressure is admitted to the heating system in the usual manner and, when the vapor or steam has filled the entire system sufficiently to expel the air, if any means are provided to prevent the return of the air, and the water temperature is allowed to fall to 32° F. in the boiler, the vacuum gauge will show 30 in. of vacuum.

If, now, a bit of heat is applied, enough so that the barometric pressure shows 18/100 in. mercury pressure, a bit of vapor will evaporate into the system and if the pressure is maintained perfectly the evaporation will continue. This, then, would be an evaporation produced under about 1½ oz. absolute pressure.

This vapor, of course, contains heat, but it is exceedingly light and would require a space of 3294 cu. ft. to hold enough of it to weigh 1 lb. That pound would contain 1073.3 B. T. U. That is the real starting point in measuring the heat units contained in the vapor, but it is also the starting point in securing steam, or vapor, if you prefer, under less than atmospheric pressure, but nevertheless produced under absolute pressure, just as certainly as vapor or steam produced under gauge pressure.

One of the things to understand clearly in this steam heating discussion is that at sea level pure water at 32° F. begins to evaporate as soon as the mercury pressure begins to increase, because of applied heat beyond the pressure of whatever surrounds it. One other thing necessary to remember is that air can be compressed under tremendous pressure until it becomes a solid and if this solid air were placed on a cake of ice, the heat in that ice would cause the compressed air to boil in the open air at 14.7 lbs. pressure, which goes to demonstrate the latent heat there is in water at 32° F.

As the absolute pressure is increased, the so-called vacuum in the heating system decreases. Also the latent heat, or number of heat units, increases and the space required to hold 1 lb. of the vapor or steam decreases.

Perhaps at this point it may be well to give the Webster Dictionary definition of vapor and also of steam. Vapor is defined as "any substance in the gaseous or aeriform state, the condition of which is ordinarily that of a liquid or solid." Steam is defined as "the elastic aeriform fluid into which water is converted when heated to the boiling point." Please bear in mind the fact that water boils under 1 lb. of absolute pressure as freely as it does under greater pressure. Therefore, it is not worth while to quarrel with one who calls the evaporation from water as at less than atmospheric pressure steam.

With this clearly understood, let us examine our problem, considering the evaporation produced with a pressure equal to 18/100 of that of the atmosphere, and also at 13.7 lbs. less than atmosphere or 1 lb. of absolute pressure; also at 10 lbs. and 14.7 lbs. absolute pressure and at 5 lbs. and 10 lbs. gauge pressure, and note the temperature of the water above 32° F. of each, the latent heat of each at each point, and the cubic space required to hold 1 lb. of the evaporation, which, you will notice, is always created under an absolute pressure, whether you call it vapor or steam. I will put it in the form of a table to save space:

A careful study of the table, plus a little experience in heating, will settle a number of things for Inquirer or others who may have been at a loss to explain upon what the so-called vacuum heating men base their claims.

It is easily demonstrated that it will take more coal to raise water to the steam point under 10 lbs. gauge pressure, or a pressure equal to a column of mercury 60.9 in. high, which is the same thing, than it will to raise water to the steam point under a pressure of 14.7 lbs., or 29.91 in. mercury pressure. It is just as easy to demonstrate that it will require less coal to raise the water temperature under a mercury pressure of 20.36 in. than will be required when the pressure is 29.92 in.

But Inquirer must not stop at this point, if he wishes to quite fully understand his problem. He must take note of the fact that in a heating system the weight of the vapor or steam steadily increases as the pressure is increased, and also that the vapor or steam steadily decreases in the volume required to weigh 1 lb., and also that the heat units available constantly grow less and less as the pres-

CONDENSED TABLE OF THE PROPERTIES OF SATURATED STEAM AT VARIOUS ABSOLUTE PRESSURES OF MERCURY COLUMN FROM 18/100 IN. TO 60.9 IN MERCURY.

Mercury Pressure In Inches	Absolute Pressure In Pounds Per Sq. In.	Temperature Deg. F.	Total Heat Above 32°, Heat Units. Water	Steam	Cubic Feet Space That Will hold 1 lb. Steam	Weight of 1 Cu. Ft. Steam. In Pounds
0.18	0.0886	32	None	1073	3294	0.000304
2.036	1.	101.83	69.8	1035	333	0.00300
10.18	5.	162.28	130.1	1000.3	73.33	0.01364
20.36	10.	193.22	161.1	982	38.38	0.02606
29.92	14.7	212	180	970.4	26.79	0.03732
40.72	20 or 5 lb. Gauge	228.1	196.1	960	20.08	0.04980
60.9	25 or 10 lb.	240.4	208.4	952	16.32	0.0614

sure decreases. He will note that the vapor he produces at 212° F. requires nearly 27 cu. ft. of space to hold 1 lb., and that 1 cu. ft. weighs almost 4/100 lbs. He will also note that at what he calls 10 in. of vacuum, the vapor will fill 38.38 cu. ft. to the pound and that it weighs about 26/100 lbs. per cu. ft. He will also note that that there is a very slight percentage greater push per cu. ft. to the so-called vacuum-vapor than there is to the vapor at 212°. He will bear in mind, it is presumed, as the air is excluded with its 14.7 lbs. pressure, that there is less friction to overcome. His young man who is handy at figuring will undoubtedly be able to figure a satisfactory loss of friction from this.

While I trust the foregoing may throw some light on the question raised, there is another phase of the heating question which it would be well to consider. The gain in heat from a radiator due to the increase in gauge pressure comes largely from the decreased space required to hold 1 lb. of steam and the consequently larger number of heat units that can be delivered. While steam at 10 lbs. gauge pressure has only 952 B. T. U. per pound, the volume, as compared with steam at atmospheric pressure and 970.4 B. T. U., is much less. The difference in volume permits, at the higher pressure and difference in weight, friction and so on, an increase in heat units delivered far in excess of the difference in the temperature of the heating medium.

Brookline, Mass. E. R. PIERCE.

An Engineer's Comments on Unit Ventilators.

"In an attempt to simplify the operation of ventilating plants," writes Samuel R. Lewis in the *School Board Journal*, "there has been introduced a unit system in which the conventional radiators and fans are replaced by individual steel cabinets, each containing a fan, a motor, a radiator and a mixing damper. Fresh air is taken usually through a window opened at the bottom, in front of which the unit is placed.

"To insure operation as a ventilating machine, the cabinet should not be provided with any adjustable slides or openings through which it would be possible to rotate the old air within the room. Such provision, however, is unusual.

"It is customary to provide a transformer wherever the electric current is of the alternating type, so as to secure the much less noisy direct current.

"Complaint is made that the unit system brings in and spreads much more dust than the conventional system. Pans of water as dust catchers are provided, but are not very effective.

"Since nearly all makes of unit heaters have but one radiator, the only method of temperature control is by dampers. As there are no separate tempering heaters, the tendency is for a hot air delivery or a cold air delivery, with abrupt changes between the two extremes. Automatic temperature regulation is necessary, therefore, and even with automatic temperature regulation functioning there is danger of drafts.

"The unit heaters nearly all deliver the fresh air vertically, at the window side of the room, using the ceiling as a deflector or spreader. The distribution of fresh air from such a delivery point to the occupants is rather favorable.

"The encasement of the radiator in a steel jacket which to a great extent prevents local over-heating of the people by radiation, is decidedly favorable.

"The exterior appearance of a building having unit heaters, with its unsymmetrical windows or partly open inlet windows, is noticeable. The electric consumption is low, because the frictional resistance is light. Where other radiators than those in the ventilating cabinets are installed, the objection inherent to the split system is encountered, that the room may be heated sufficiently for occupancy without ventilating it.

"When unit heaters are used without individual fireproof vent flues from each classroom, but with the corridors and stair halls made to serve as vent flues, there is danger, in case of fire, of the stairways becoming chimneys. This is prejudicial to the easy escape from the building of the pupils."

Court Promulgates Code of Principles Governing Trade Associations.

What is described as a code of principles governing trade associations and defining what they are prohibited from doing is contained in a decree issued recently by Federal Judge Knox, dissolving the Gypsum Industries Association. The decree also restrains the gypsum interests from forming any similar association which would restrain or monopolize trade and commerce in gypsum products. The decree places the ban upon the following practices:

Agreeing to fix prices or charging uniform prices; agreeing to advance or decrease prices; agreeing to advise or communicate with each other regarding proposed advances or decreases in prices; agreeing to limit, curtail, restrict or control the amount of products to be produced for manufacture at any time; agreeing as to the territory in which any or all the defendants may sell or dispose of their products.

Agreeing to effect any discrimination, in prices or otherwise, in favor of or against any purchaser because such purchaser is a mail order house, purchasing agency, cooperative buying association or so-called "dealer"; agreeing to use a published credit list and information for the purpose of blacklisting an undesirable purchaser; agreeing to fix terms, discounts or prices to be followed by a dealer, jobber or other middleman upon his resale to a consumer; agreeing to adopt or follow any price list published or compiled by themselves or any newspaper or periodical as a fixed price; agreeing to enforce any arbitrary freight rates; agreeing that certain manufacturers manufacture a certain gypsum product and that all other manufacturers desist from the manufacture of such composition.

The acts permitted are such as can do no injury to the trade or other industries or individuals.

Use of Stairway for Air Grilles.

Using stair risers for return air intakes is a development which has been adopted with success by Charles S. Weatherly, of Grand Rapids, Mich. The accompanying illustration shows a stairway so arranged. This is in a residence which has two warm-air registers at the floor line and three grilles in the stair risers. The registers are of the usual type, the upper grille being of wood and the two lower ones of metal. There is also a grille in the kitchen stairway riser, not shown in the illustration.

A galvanized-iron duct under the stairs connects the grilles to the warm-air furnace and there are also two other cold-air return ducts from the lower part of the house.

Courtesy Warm Air Heating and Sheet Metal Journal.

USE OF STAIRWAY FOR AIR GRILLES.

Chats With Uncle Ben

Forced Draft Furnace

I had a letter from a dear old friend, enclosing a sketch of a new scheme for thorough and perfect combustion which he had invented, and asking me to report what Uncle Ben thought about it. I guess he hoped that maybe Uncle Ben would wax enthusiastic about it and perhaps want to buy the patent. He was convinced, anyway, that if people only understood, this invention would make him rich and famous.

I think the Patent Office at Washington is one of the most tragic places in the world, reeking as it does with little dead bodies of forlorn hopes.

Anyhow, I caught Uncle Ben as he smoked a Carolina in front of his wood fire, and here is his report:

"Your friend, I take it, has a patent on the combination of a grate which can be hoisted up and down a foot or so, as may be desired, under a hollow reverberatory arch, which has openings for permitting air to squirt down toward the grates, the jets being pretty well distributed over the grates. In connection with this he has a blower with at least five valves on its five connections.

1. On the inlet to the blower from the breeching
2. On the inlet to the blower from the boiler room
3. On the outlet from the blower to the ashpit
4. On the outlet from the blower to the breeching
5. On the outlet from the blower to the hollow arches.

"I gather that you put a charge of coal on the grate, and having the coal ignited you start the fan, blowing air down on top of the coal. This air may be diluted with hot products of combustion or may be taken from the boiler room. When the fuel burns a little it may get too far away from the reverberatory arch to receive the best effect from the jet of air from above, so you jack the grates up nearer to the arch gradually, until, needing a fresh dose of coal, you lower the grate again and fill the void with coal.

"Strikes me that between diddling the five valves, toting in coal, shaking down ashes, raising and lowering the grates and bossing the job, the fireman will be very busy.

"I don't doubt but that there will be a period during every cycle when, with the arch hot and the coal incandescent, there will seem to be very perfect combustion. I am very sure, however, that this cannot be continuous, even though there seems to be a sort of hand stoker effect hoped for. A shaking grate of any real size loaded with fuel weighs thousands of pounds, and to keep lifting and lowering it by hand is decidedly impracticable.

"After all, what we burn in a fire is mostly carbon and oxygen, and the manipulator of the five valves must watch his business sharply or he will be delivering so much inert combustion product to his fire that he will extinguish it. It's very sweet to think of getting nice hot gas out of the combustion chamber and how blazing hot it makes the fire, but remember, if carried to its logical conclusion such a process has nothing on the man who lifts himself by his own boot straps.

"If you or I could invent a substance which could be suspended over a hot fire and which would serve to convey comparatively cool air there, and which would act as lips for the orifice which squirted the air down on the fire, and which would *last, endure, hang on, stick*—Oh, boy! we'd not worry about Uncle Ben's opinion nor who'd buy the patent from us!

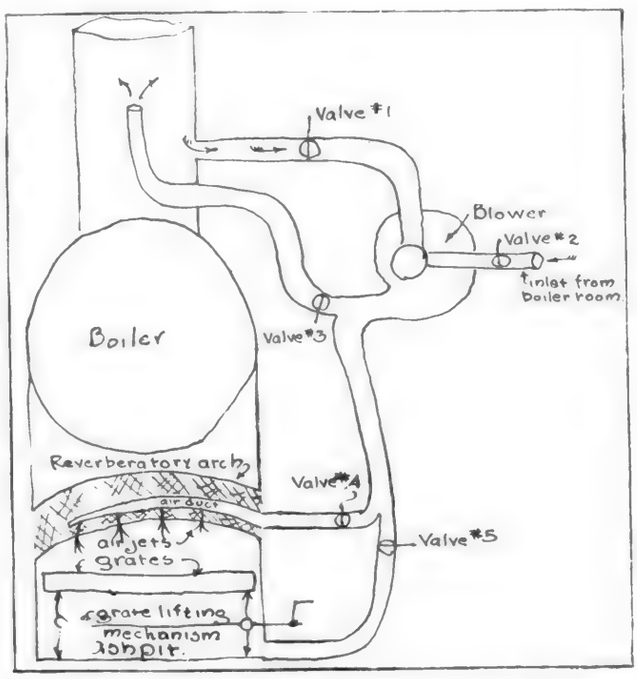
"Why, they have tried almost every conceivable substance for such places, and to the best of my knowledge every substance has failed, from all sorts of refractories to exceedingly costly metallic alloys. They have tried to water cool 'em and air cool 'em, and today, do the best we may, the only kind that stands up long enough to bother about has to be divorced from the air jets altogether, and these have to be brought in below the fire in the tuyeres in the grates. No material which can bear the fire temperature will stand for the terrific internal strains due to the varying air temperatures.

"Anyhow, even if this stump could be steered around, I wonder what the bunsen burner jet would do to those grates, shooting down against them some time when the fireman has screwed them up close and stopped to light his pipe? They'd refrain from melting very little longer than the proverbial snowball, I'm afraid.

"Suppose these things didn't count, and suppose the machine could be operated, who is going to furnish power for the fan?

"If we had a battery of boilers, there would have to be a separate air jet control for every one of them, lest some one boiler gets a hole in the fire before its neighbors.

"The experience I have had with things of this kind leads me to believe that there would have to be an ample mixing and expanding space for the products of combustion behind the grates, and an incandescent arch there somewhere, before smokeless combustion could be guaranteed, anyway."



SKETCH WHICH I SHOWED TO UNCLE BEN.

Recommended Minimum Requirements for Small Dwelling Construction.

A report just issued by the Building Code Committee of the Department of Commerce, containing recommended minumum requirements for small dwelling construction, is characterized by Secretary Hoover as "having a value far beyond any similar work undertaken to date." The committee recommends in its report the minimum requirements which it believes should be enforced by cities in their building codes for one and two-family houses, and in appendix discusses good practice in small house construction. The 100-page printed report is now available at a nominal price. It not only presents a model ordinance which cities may adopt, but serves as a guide

to all those interested in showing where to save and where to spend in order to obtain a safe, substantial and durable house at a minimum cost House of masonry, concrete and frame construction are dealt with, the value of such construction in the United States having amounted to well over $1,000,000,000 in 1922.

The report recommends that building codes permit 8-in. solid brick and 6-in. solid concrete walls for two and one-half and three-story dwellings accommodating more than two families each, that 8-in hollow building tile, hollow concrete block, or hollow walls of brick (all rolok) should not exceed 20 ft. in height to the gables; and that frame construction be limited to two and one-half stories.

Legal Decisions

Michigan Statute Regulating Installation of Warm-Air Furnace Plant Held Void as Class Legislation.

The Michigan Supreme Court, in Peninsular Stove Co. v. Burton, 189 N. W. 880, has affirmed a decree enjoining the enforcement of Michigan Pub. Acts 1919, No. 384, which provides for the regulation and supervisory control of the installation of warm-air heating plants inclosed in metal with more than one pipe, holding it to be unreasonable class legislation and so opposed to the State and Federal Constitutional provisions as to due process and equal protection of the laws. The court says: "It is elementary that all property is held subject to the general police power to regulate and control its use so as to secure the general safety and all reasonable provisions enacted for the prevention of and protection against conflagration is generally recognized as a proper exercise of such power. But legislation to that end must not be unreasonable or discriminatory. It must not single out any class of persons or things and arbitrarily impose burdens upon them not applying to others within the same general class.

"The record shows that there are several kinds of heating plants, steam, hot water, warm-air, and stoves, in which wood, coal or coke may be used as fuel. Out of these the legislature selected a class, warm air, for this special regulatory legislation. While the title indicates an intention to regulate all plants of this class, the first section of the act confines its operation to furnaces 'inclosed in galvanized sheet-iron.' Of this class an exception is made of those which are pipeless or have but one register. We have, therefore, not only the selection of a class of heating plant, but of a class of this class. To justify such action it must appear that some substantial reason existed for the regulation of this particular kind of heating plant not equally applicable to the others. Is there greater danger of fire from a plant thus installed, than from other warm-air heating plants? The fire hazard due to the overheating of the furnace itself may be greater when it is enclosed in metal than in brick, but no such claim can be made as to the smoke pipes or the pipes leading to the rooms or the registers.

"It seems clear to us that the classification here made is not based upon any real or substantial distinction. No sufficient reason has been pointed out for exercising the supervisory control provided for in the act over the installation of a warm-air heater inclosed in metal with more than one pipe, which does not equally apply to one inclosed in brick, or one which has but one pipe."

Possibilities of the New Year.

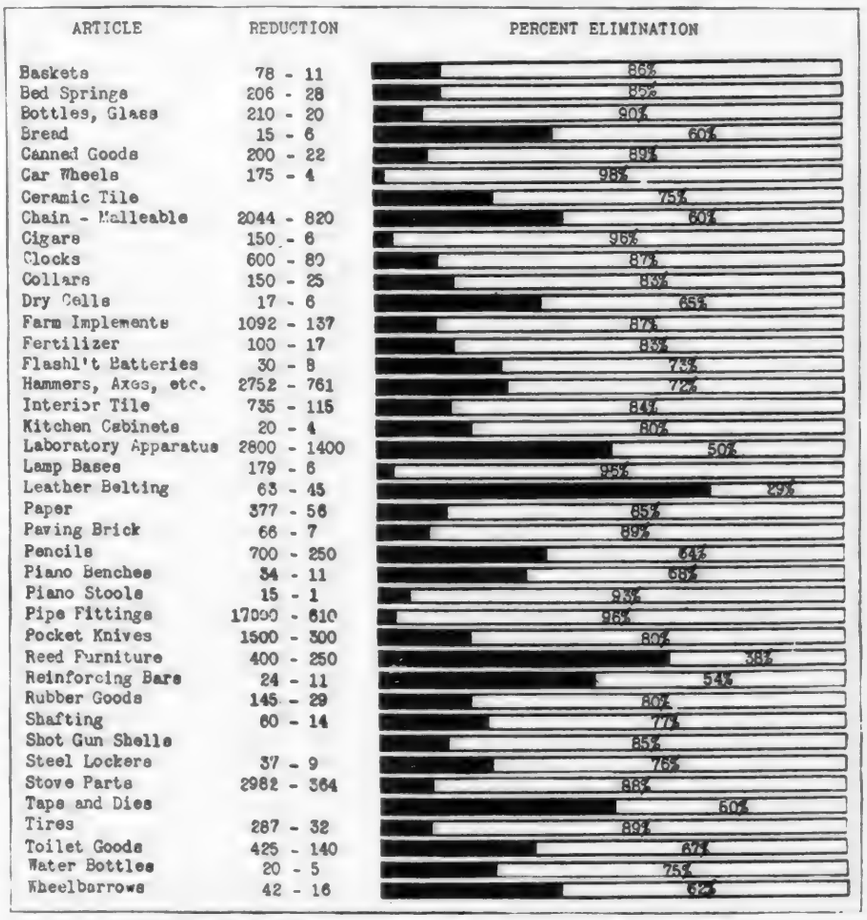
A clear idea of the building work carried out in 1922 is given by the National Trade Extension Bureau in the statement that for every house that was built in 1921, two have been built in 1922. In 1921, 27 northeastern states spent $688,000,000 for homes, while in 1922 they have spent approximately $1,500,000,000. While house building has made the most spectacular record, the building revival was responsible for impressive increases in the number of office buildings, factories, schools and stores.

There is every indication, declares the bureau, that the building activity will continue throughout 1923 with at least the same pace. A survey just made by the National Association of Real Estate Boards shows that out of a total of 184 cities scattered over the country, 121 cities still report a housing shortage.

The only danger, continues the bureau, that lies in the road of increased building for 1923 is that of the elevation of prices of building materials and labor. Both labor and material men, it is declared, should realize that it is better for them to have steady business at moderate profits than to have a short spurt of building at higher profits, followed by a long period of idleness. To "bull" the price on building materials, warns the bureau, will unquestionably choke off business. This same warning applies to labor, for wages, the bureau claims, are already as high as they can be and still allow a profitable volume of building.

Recent Progress in the Elimination of Waste.

That avoidable waste in American Industry is being rapidly eliminated is shown in an industrial survey recently made by the Fabricated Production Department of the Chamber of Commerce of the United States. This applies particularly to the cutting down of the number of varieties and styles in the different commodity lines.


ARTICLE
REDUCTION
PERCENT ELIMINATION
Baskets 78 - 11 86%
Bed Springs 206 - 28 85%
Bottles, Glass 210 - 20 90%
Bread 15 - 6 60%
Canned Goods 200 - 22 89%
Car Wheels 175 - 4 98%
Ceramic Tile 75%
Chain - Malleable 2044 - 820 60%
Cigars 150 - 6 96%
Clocks 600 - 80 87%
Collars 150 - 25 83%
Dry Cells 17 - 6 65%
Farm Implements 1092 - 137 87%
Fertilizer 100 - 17 83%
Flashl't Batteries 30 - 8 73%
Hammers, Axes, etc. 2752 - 761 72%
Interior Tile 735 - 115 84%
Kitchen Cabinets 20 - 4 80%
Laboratory Apparatus 2800 - 1400 50%
Lamp Bases 179 - 6 95%
Leather Belting 63 - 45 29%
Paper 377 - 56 85%
Paving Brick 66 - 7 89%
Pencils 700 - 250 64%
Piano Benches 34 - 11 68%
Piano Stools 15 - 1 93%
Pipe Fittings 17000 - 610 96%
Pocket Knives 1500 - 300 80%
Reed Furniture 400 - 250 38%
Reinforcing Bars 24 - 11 54%
Rubber Goods 145 - 29 80%
Shafting 60 - 14 77%
Shot Gun Shells 85%
Steel Lockers 37 - 9 76%
Stove Parts 2982 - 364 88%
Taps and Dies 60%
Tires 287 - 32 89%
Toilet Goods 425 - 140 67%
Water Bottles 20 - 5 75%
Wheelbarrows 42 - 16 62%

PROGRESS OF CAMPAIGN FOR ELIMINATION OF WASTE.

General Plan Adopted for Ventilating Hudson River Vehicular Tunnel

Further information is now available regarding the plans for ventilating the vehicular tunnel now in process of construction under the Hudson River, between New York and New Jersey, through the publication in *Mechanical Engineering* of the developments to date in this project. Most of these developments have been published in The Heating and Ventilating Magazine, special articles on the subject appearing in the issues for April, 1918; May, 1921; December 1921; and May, 1922.

The general plan of ventilation adopted is as follows: Blower fans located in buildings over the four shafts will supply the required amount of fresh air to the main fresh-air duct located under the tunnel roadway. The air will then pass through flues to continuous expansion chambers, one on each side of the roadway, thence through a continuous slot to the roadway. The air remains in the tunnel an average of 1½ min., during which time it slowly ascends from the roadway to the ceiling. Exhaust fans located in the same buildings with the blower fans will draw the vitiated air through ports in the ceiling and thence through the upper duct, delivering it through stacks to the outer atmosphere. In this way fresh air will be supplied in the proper amount to all points throughout the tunnel. There will be no discomfort or danger from high-velocity air currents and the exhaust gases will be quickly diluted and removed.

There is one feature in this work which, it is stated, is worthy of special mention, and that is the clear realization of the fundamental idea that the safety and even comfort of those riding in the tunnel must be carefully considered.

Smoke and noxious gases, though of different character, have always been present in railroad tunnels, especially those of considerable length, and have made travel in them anything but pleasant. When these tunnels were built, however, the idea of caring for the comfort of passengers to the extent of providing them at all times with clean air had not yet been conceived. Those who had to travel could not avoid riding through the tunnels, and whatever discomfort they experienced did not seem to affect the business of the railroad companies.

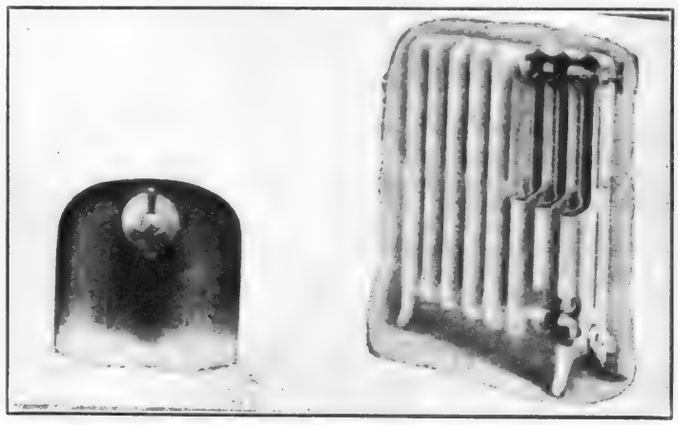
Invisible Radiator Connections.

An English firm, the Beeston Foundry Company, has put out a unique type of invisible radiator connection, according to a design of Frederick W. Dye and described by him in a recent issue of *The Plumber and Journal of Heating* (London). It is intended to make the radiator a more sightly fixture and thus overcome the prejudice which exists to a wide extent in England to the use of radiators for residence heating.

As designed, the pipe connections were placed between the legs or feet of the radiator at each end. This, however, made it necessary to provide a regulating valve in the connecting pipe. To overcome this it was decided to use the first section of the radiator as a continuation of the flow connection and have an internal valve at the top.

The accompanying illustrations shows how this was accomplished. The pipe connections will be seen between the legs of the radiator. The valve, it will be noticed, closes on a faced nipple between the first and second sections at the top, while the nipple between these sections at the bottom is of solid metal. So far as the circulation is concerned, the result is the same as with an ordinary radiator which has a flow pipe carried up and connected at the top. The valve is quick-opening, from open to closed with about three-quarters turn of the wheel handle.

Additional illustrations are included, showing a similar valve as fitted and supplied by the National Radiator Co., Ltd., of London.



VIEWS OF RADIATOR WITH VALVE CLOSING ON A FACED NIPPLE BETWEEN FIRST AND SECOND SECTIONS.

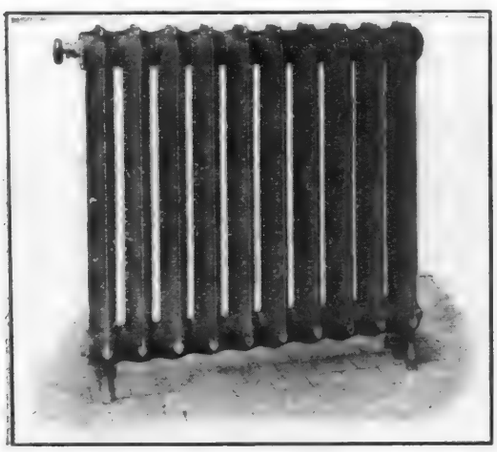
Invention to Cut Down Vibration.

An invention to control vibration set up by small bodies revolving at high speeds, as, for example, the armature of a fractional horsepower motor turning at the rate of 10,000 R. P. M., is announced by Richard Soderberg, of the engineering department of the Westinghouse Electric & Mfg. Company. Mr. Soderberg has applied for patents on the device which is suitable for applying to the balancing and rotating parts of motion.

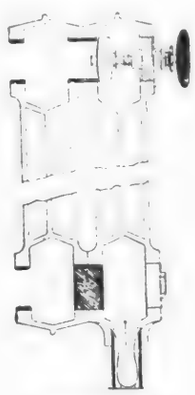
It is stated that the machine invented by Mr. Soderberg makes use of the principle of dynamic or running balancing. The machine will first be applied to the balancing of armatures for small motors.

A Graphic Description of Relative Humidity.

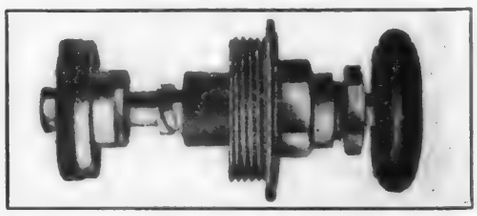
"Imagine a sheet of rubber," says Samuel R. Lewis in the *School Board Journal*, discussing the difference between the relative humidity of warm and cool air. "Paint it with white paint at its normal size. You can see the paint separating



RADIATOR WITH INVISIBLE CONNECTIONS.



METHOD OF BLANKING OFF END SECTION.



CONSTRUCTION OF VALVE FOR INVISIBLE RADIATOR CONNECTION.

into tiny particles when you stretch the rubber, until at high tension the paint has disappeared. We take perfectly good, well-balanced outside air which carried from 50% to 100% of the amount of moisture it can carry, depending on the sun, the time of day and some other factors, and we heat it until it has expanded until it carries only 30% to 20%, or even less, of the amount of moisture it can carry. It proceeds to get very busy stealing the missing moisture wherever it may. It gets much from our skins, lips and throats. Whenever water changes from a liquid to a gas by evaporation, heat is used. The heat comes from our bodies, so that following evaporation we may feel cool at 80° dry-bulb, with low humidity."

Another House Heated by Electricity.

A good idea of the possibilities in heating a house by electricity with a power rate of 3½ to 2 cents per kilowatt-hour is afforded in the case of the Gute "home electrical" on the Berkeley Hills, near San Francisco, described by Lois Codd in *Electrical Merchandising*.

In each room of this house there is a special convenience outlet on its own 220-volt circuit to which a Wesix electric heater can be attached. This heater is a San Francisco product. A hollow core of fire clay wound with nickel-chromium coil comprises the heated area over which the air circulates. A sheet of planished copper behind the cores makes the operation of these heaters of both the convection and radiant types. Each core consumes 1000 watts.

In the Gute home the smaller rooms are quickly and economically heated by a 2,000-watt heater, while a 5,000-watt heater is used in the library and one of 6,000-watts rating has been modeled into an electric fireplace.

It is estimated that the cost of a chimney and mantel which would match the rest of the Gute home would be at least $1,200, but the entire outlay for this electric fireplace did not exceed $160. The fireplace is provided with a three-heat switch so that the temperature of the room can first be raised to the desired point by all the coils, and then maintained there by two coils, which, under the power rate, consume only 4 cents worth of energy per hour. Beyond this economy there is also the advantage that no heat is lost up a chimney, and further there is the absence of all dirt or smudge in the house, annoyances inevitable when gas, wood or coal are used.

A 6,000-watt electric water heater keeps the house hot-water supply tank always full. This heater is designed in much the same way as the air heater, but with the water passing through the center of the cores, automatic temperature control is provided by a rugged thermostat.

In every room of this house there are from two to six regular 110-volt convenience outlets in the baseboard and all of these are in practically constant use. Every kind of appliance from the electric curling iron to the electric phonograph or cigar lighter can be attached, each at the most convenient point.

The kitchen, spotlessly white because it has never known any but an electric stove, is a joy to behold with its electric dishwasher, electric refrigerator, electric range and utility motor for beating eggs, polishing silver, etc. The flatiron is of especial interest because of an automatic control by which the cord "flips out" when the iron becomes heated over 575°.

ELECTRIC AIR HEATING EQUIPMENT FOR GUTE "HOME ELECTRICAL."

Room.	Heater Circuit, 220 volts.
Living room	Heater, 6000 watt, 20-amp. outlet. Fireplace fed by No. 10 gauge wire.
Music room	6000-watt heater.
Library	6000-watt heater.
Dining room	6000-watt heater.
Breakfast room	2000-watt heater.
Kitchen	2000-watt heater. Electric range on special switch.
Four bedrooms	20-amp. outlet on No. 10 gauge wire for 2000-watt heaters.
Sewing room	20-amp. outlet fed by No. 10 gauge wire for 2000-watt heater.
Bathroom	20-amp. outlet fed by No. 10 gauge wire for 2000-watt heater.
Laundry	6000-watt water heater for house hot water supply.
Billiard room	3000-watt fireplace.

National Leadership for the Engineer.

Some of the comments made by President Dexter S. Kimball of the American Society of Mechanical Engineers in his classical address at the annual meeting of that body, strike home with peculiar force to the heating and ventilating fraternity. Here, for instance, is one point he made.

"It will be freely conceded that the preparation of the engineer for these new duties (national leadership) is far from adequate, and two of his shortcomings stand out conspicuously. The first is his lack of knowledge of the economic principles of industry and commerce. It is true, of course, that the field of abstract economics is still far from being an exact science and many of its theories are controversial. But that is no excuse for a lack of knowledge, on the part of the industrial manager, of this important and growing subject which aims to replace ignorance and empiricism with accurately reasoned results. Furthermore, every engineer is by nature an economist. The location of an industrial plant, the design of a great power house, the location of a railway are all problems in economics, and the tangible things with which economics is concerned are familiar objects to every engineer. This need in the equipment of the engineer is now fully recognized, and in a fair way to be remedied. All first-class engineering colleges now prescribe more or less economic study and students of engineering recognize this study as a necessary part of their mental equipment."

At the same time President Kimball was quick to state that "over against the weaknesses of the engineer must be placed certain inherent qualities that strengthen his claim to industrial leadership. He is as a class essentially honest. His entire training and professional experience are such as to demand honesty of thought and purpose in all of his transactions. It is true, of course, that here also there are exceptions, but they are comparatively rare ones. Engineers as a class are honest, and if anything is needed today in management more than anything else, it is this ancient virtue."

As President Kimball pointed out, the National Department of Education has for some time been advocating strongly that engineering students be taught more of the fundamentals of business and that young men preparing for the field of business and commerce be instructed in some of the outstanding features of engineering.

"It may yet be," he declares, "that we shall develop a combination of these two fields that will produce a new type of industrial leader."

First Annual Conference of Association Secretaries.

A unique meeting was held in Evansville, Ind., January 9-11, at the headquarters of the National Trade Extension Bureau, when the secretaries of trade associations connected with the heating and plumbing field assembled for their first annual conference. As was stated by Secretary-Manager William J. Woolley of the bureau, in his welcoming address, the conference was called primarily for the purpose of getting together and disseminating opinions and ideas on association work, and also to show the secretaries first hand what kind of an organization the National Trade Extension Bureau is. Among the national organizations represented were the National Pipe and Supplies Association (George D. McIlvaine, secretary); National Association of Master Plumbers (President John S. Irvine, Executive Clerk J. W. Cannon, Jr., and Secretary William Hughes); and Heating and Piping Contractors' National Association (Vice-President J. B. Walker and Secretary Henry B. Gombers).

Among the addresses delivered and topics discussed during the three-days' session, were the following: "The Value of an Asssociation," "Plan of Operating an Association," "A Budget System for an Association," "The Work of the Employment Committee," "The Work of the Cost Committee," "The Work of the Membership Committee," "Uniform Association Guarantee" "The Duties of the Secretary," and "Association Bulletins."

In connection with the discussion of "The Work of the Employment Committee," L. T. Braun, of the Chicago Master Steam Fitters' Association, told how the Chicago apprenticeship arrangement was based upon the work of a committee of ten men, five from the journeymen's union and five from the master fitters' association. Shops, he said, are allowed one apprentice for every three-fifths of a journeyman up to three ap-

prentices for a shop. A desirable arrangement, he said, would be one apprentice to every journeyman, but that seemed to be unattainable. Examination of apprentices is made every six months as to progress. Wages start at 45 cents an hour for the first year, and are raised to 50 cents the second year, 55 cents the third year, 60 cents the fourth year and 65 cents the fifth year. Apprentices must attend Washburn Continuation School one day every two weeks, with full pay from their employers. Mr. Braun stated that 230 boys are in school as apprentices under this arrangement.

The total attendance at the conference was 111, which included 92 delegates.

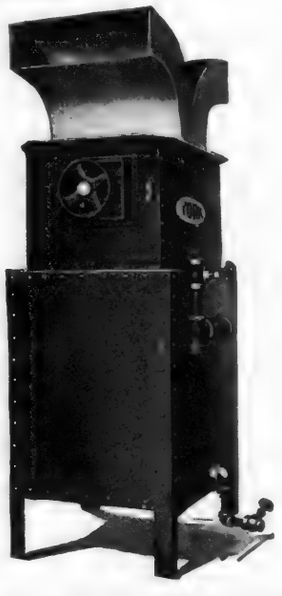
Portable Unit Fan Blast Heaters

Previous articles in this series are as follows: 1—The Baetz Heater, July, 1922; 2—The Ilgair Unit Heater, August, 1922; 3—Wing-Scruplex Unit Heaters, August, 1922; 4—The Bayley Thermo-Units September, 1922; 5—"ABC" Portable Heating Units, September, 1922; 6—Sturtevant Unit Heaters, October, 1922; 7—Twinvent Unit System, January, 1923.

The York Welded-Coil Unit Heater.

A portable unit heater which embodies some unusual ideas designed to make it especially adaptable for industrial plant heating or ventilating, or both, was put on the market last year by the York Heating & Ventilating Corporation, Philadelphia, Pa., under the name of the York welded-coil unit heater.

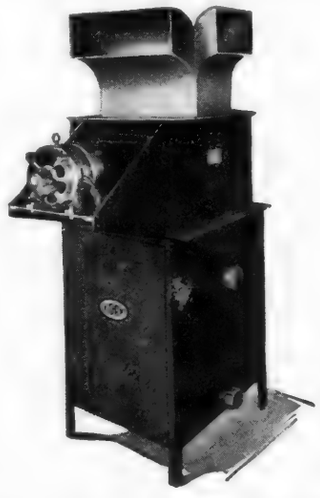
One of its original features is the absence of any joints in the coils which form the heating surface. This is accomplished by welding all the pipes into both the supply and drip headers. These coils are made of a fine grade of pipe, carefully selected, and after the coils are made up and welded, they are tested to a pressure of over 200 lbs.



YORK UNIT HEATER WITH STANDARD ARRANGEMENT FOR PULLEY DRIVE.

The units are suitable for use on either vacuum, low-pressure or a high-pressure steam system up to 150 lbs. working pressure. Steam is admitted at the top in a header which runs the full length of the coil, and the water of condensation is taken from a similar header at the bottom. As both the supply and return headers are inside the unit, all the heat radiated from the headers is not lost, but goes into the air passing through the heater.

Another distinctive feature of the York unit is the fan which causes the circulation of air through it. The fan shaft is mounted on ball bearings and the fan wheel is of the double-inlet type, to insure a quiet operating machine, free from vibration. This feature of the York unit serves



YORK UNIT HEATER WITH DIRECT-CONNECTED MOTOR.

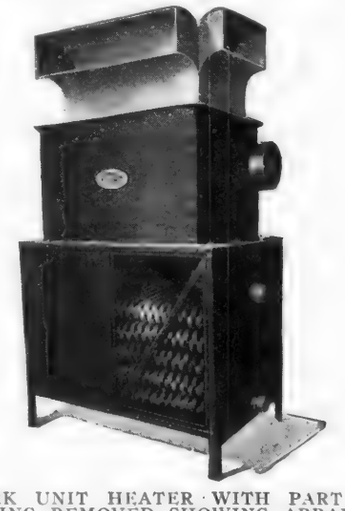
to reduce the power required for the work accomplished. The bearings are mounted entirely outside the fan casing, so that the hot air is not in contact with them, and additional grease lubrication can be added when necessary without disturbing the casing of the unit.

The units are ordinarily made to be supported from the floor, and the fan is at the top. If it is desired to drive the unit by belt connection, the pulley is in a convenient location for belting to either overhead line shaft or motor suspended from ceiling. This it is pointed out obviates the necessity, as well as expense, of a belt guard. If the unit is electric motor-driven, the motor is mounted on a bracket attached to the side of the fan, and directly connected to it by means of a flexible coupling. It is far enough from the floor to keep it free from dirt or damage, but not so far as to be inaccessible

A sheet-metal discharge outlet is furnished as a part of each unit, and may be arranged to discharge in either two, three or four directions.

Another ingenious idea incorporated into the design is to have the cold air enter at the bottom on all four sides. This reduces the velocity at the entrance, at the same time removing cold air from near the floor where it naturally settles. If the air is to be drawn from the outside, this arrangement permits an easily-made rectangular fresh-air connection of ample area from any one side.

The overall standard height of the various sizes averages between 9 and 10 ft., making them applicable for all industrial buildings. This height has two advan-



YORK UNIT HEATER WITH PART OF CASING REMOVED SHOWING ARRANGEMENT OF COILS.

tages, one of which is that the outlet is far enough from the floor to allow the air to be discharged at a fairly high velocity, permitting the circulation of the air over a large area without being objectionable to workmen in the building. The other is the saving of power for a large part of the heating season, through the fact that during mild weather, the unit or units may be started in the morning and operated until the shop or other building is thoroughly heated. During this process the air in the building has been put into circulation, the building has been brought up to the desired temperature, and the outside temperature has gradually increased. The power can then be shut off, and the circulation thus started will be continued, (although at a slower rate), due to the air motion set up, and the stack or aspirating effect caused by the height of the unit.

The following is a table of the various sizes giving capacity, floor space, etc.:

No.	Capacity B. T. U. Per Hour	Cu. Ft. Air Per Min.	Weight, lbs.	Floor Space	Overall Height
2	346,000	3870	1400	3′ 7″x2′ 0″	8′ 6 ″
2-A	395,000	3870	1700	3′ 7″x2′ 7″	8′ 9 ″
3	495,000	5530	1800	3′ 7″x2′ 7″	9′ 6 ″
3-A	560,000	5530	2200	4′ 0″x3′ 7″	9′ 6 ″
3-B	620,000	5530	3000	5′ 1″x3′ 7″	9′ 8 ″
4	925,000	9820	3200	5′ 1″x3′ 7″	9′ 10″
4-A	1,080,000	9820	5000	7′ 0″x4′ 0″	9′ 10″
4-B	1,130,000	9820	5800	7′ 0″x5′ 1″	9′ 10″
5	1,850,000	9820	6200	7′ 0″x5′ 1″	9′ 10″

It will be noted that the York units occupy a floor space greater in length than width, and it has been found that this makes it easy to adapt them to unused

space, so as not to interfere with plant operations. The units can also be arranged for suspension from ceiling or roof trusses, or they can be mounted on extended supports, allowing headroom underneath.

In addition to heating and ventilating ordinary buildings, such as foundries, machine and erecting shops, woodworking plants, etc., York unit heaters are especially adaptable for clearing up fog or vapor in dye houses, bleacheries, paper mills and similar plants. Another important use is in connection with dryers, especially where it is necessary to employ high-pressure steam.

Working Exhibit of Vapor Heating System.

An effective exhibit of vapor heating specialties was made by the O-E Specialty Mfg. Co., Milwaukee, Wis., at the recent Wisconsin Products Exposition, when the company had installed and in operation a complete O-E vapor heating installations, using a small Pebco round vapor boiler and two radiators elevated as shown in the accompanying illustration.

Vapor was generated with a gas burner and a pressure obtained of about 6 to 8 oz. At that point the gas supply would be cut off. Soon thereafter a vacuum would be indicated on the gauge. This was permitted to increase from 10-in. to 25 in. during which period heat was held in the apparatus for over three hours without any fire under the boiler.

The company also exhibited its O-E "3-in-1" heating specialties, including packless graduated supply valves, ball-check water seal return fittings, and O-E exhausters and vacuum valves. Other devices exhibited were O-E Rouse-type balanced swing-check valves, thermo-nickel return traps with and without Monel metal ball check, direct differential return traps, damper regulators and compound vacuum pressure gauges.

The attendance during the week of the exhibit was so large and the results so satisfactory that the company states it has already contracted for space for next year's show.

British Institution of Heating and Ventilating Engineers Shows Increased Activity.

Increased activity on the part of the (British) Institution of Heating and Ventilating Engineers is indicated in its program of meetings for the present season. Among the papers presented to date are one on "Ozone in Ventilation," by Charles G. Huntley, one on "Centrifugal Pumps as Applied to Heating Installations," by President A. H. Barker, and one on "Automatic Temperature Control," by B. R. Wingfield.

At the annual general meeting of the institution, February 6, a paper by Professor W. E. Garner, of the Chemical Engineering Department of University College was scheduled, on "Theory of Combustion of Gaseous and Liquid Fuels." Finally, at a sessional meeting, March 9, "Gas as a Fuel" will be the subject of a paper by J. G. Clarke. A smoking concert is scheduled for April 13. This event and the sessional meetings will be held at the Engineers' Club, in London.

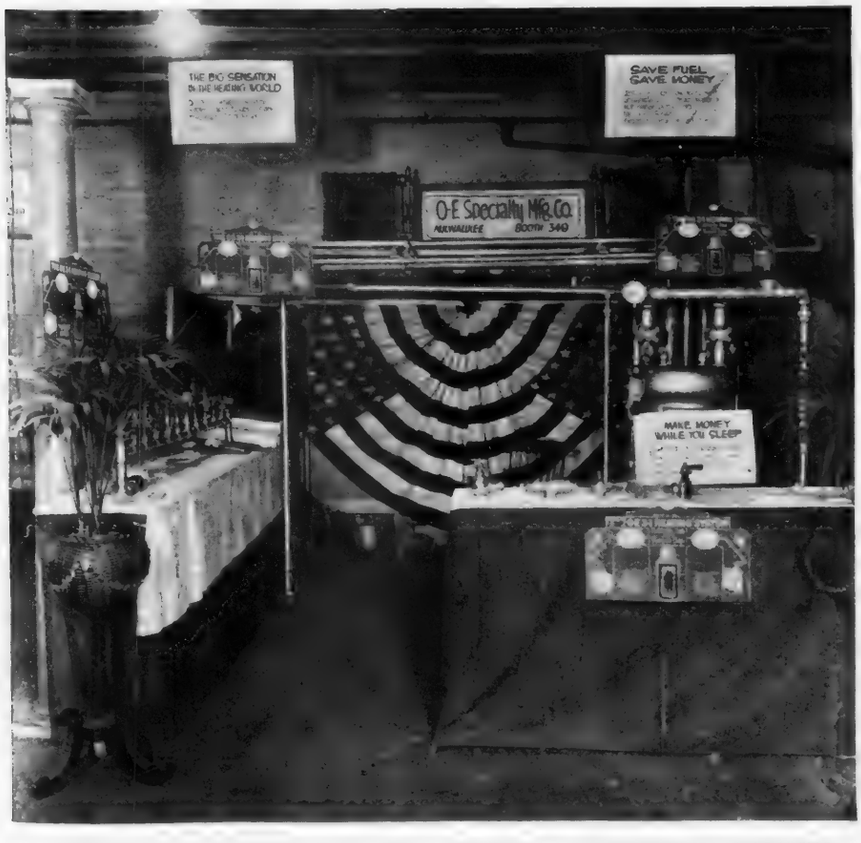


EXHIBIT OF O-E SPECIALTY MFG. COMPANY AT WISCONSIN PRODUCTS EXPOSITION.

Current Heating and Ventilating Literature.

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

CENTRAL STATIONS

Economy of Small Power Plants vs. Facts about Coal Conservation, Egbert Douglas. Indus. Management (N. Y.), vol. 64, no. 5, Nov. 1922, pp. 286-300. Discussion of question as to whether central-station developments and super-power plants are in line with real economy.

EXHAUST STEAM

Commercial Value. Commercial Value of Exhaust Steam, Fred W. Bosch. Power Plant Eng., vol. 26, nos. 20 and 21, Oct. 15 and Nov. 1, 1922, pp. 997-999 and 1047-1048, 3 figs. Notes on exhaust steam required for feedwater heating; heating value of exhaust steam shown by indicator diagrams. Enlargement of article by A. Langstaff Johnston, Jr.

HUMIDITY CONTROL

Humidity Control in Cold Storage Warehouses, Milton W. Browne. Ice & Refrigeration, vol. 63, nos. 3 and 4, Sept. and Oct. 1922, pp. 140-142 and 181-183, 2 figs. Is as important as temperatures in handling of fruits and food products in cold storage; heating capacity of air depends upon quantity of water vapor mixed with it; absolute and relative humidity; humidity, temperature and dewpoint effect; relative humidity, hygrometrical and conversion tables.

INDUSTRIAL

Power Plant of the Hoover Suction Sweeper Company. Power, vol. 56, no. 20, Nov. 14, 1922, pp. 750-754, 8 figs. Plant designed to supply heating-season-load; arrangements made for installation of three 320-hp. uniflow engines and four 3430-sq. ft. boilers.

POWER PLANTS.

Utica State Hospital. Power and Heating Plant of Utica State Hospital. Power Plant Eng., vol. 26, no. 9, May 1, 1922, pp. 449-456, 12 figs. Description of central installation to supply heat, light, water, and power for institution approaching proportions of a city.

POWDERED FUEL.

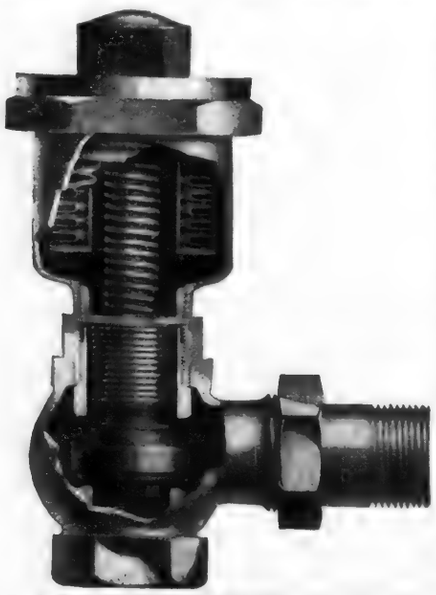
Office-Building Heating. Powdered Fuel. Nat. Engr., vol. 26, no. 5, May, 1922, pp. 219-221, 1 fig. Results from installation in 42-story L. C. Smith building, Seattle, Wash.

Steam Boilers, for. Powdered Coal under Steam Boilers, H. D. Savage. Coal Trade Jl., vol. 52, nos. 36, 37, 38, 39, 40 and 41 Sept. 7, 14, 21, 28, Oct. 5 and 12, 1921, pp. 1003-1004, 1028-1029, 1049-1051, 1074, 1094-1095 and 1116-1117, 5 figs. Progress made in making powdered coal for steam production thoroughly reliable and efficient, and economic possibilities of this method of combustion.

New Trade Publications

VENTILATING WITH CLARAGE KALAMAZOO MULTIBLADE FANS is demonstrated in an impressive manner in a catalogue bearing that title, just issued by the Clarage Fan Co., Kalamazoo, Mich. No less than 37 photographs are reproduced of buildings where Clarage Kalamazoo multiblade fans have been recently installed for ventilating work. Special attention is called by the company to the names of the architects and engineers who have specified Clarage equipment. In the concluding pages an illustrated description is presented of these fans and the point is made that Clarage standard bearings are furnished on all sizes. These are described as the best ring-oiling, babbitted bearings obtainable. They have an unusually large bearing surface and are self-aligning in all planes. They have felt washers at either end of the outer case to keep the dirt out and the oil in. The multiblade fans are built in sizes No. ½ to No. 10, the number of the fan indicating the approximate diameter of the fan wheel in feet. The company emphasizes the fact that with the exception of the motors and Vento heaters, it manufactures all the equipment necessary for a complete heating, ventilating and humidifying system, including fans, pipe coil heaters, air washers and engines. Size 9 x 6 in. Pp. 48.

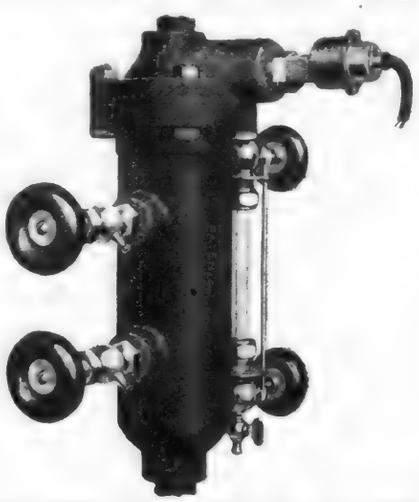
BISHOP & BABCOCK COMPANY'S MULTIFLEX SEAMLESS BELLOWS, built on the solid-head principle, are brought to the attention of the trade through the publication by the Bishop & Babcock Company of the decision of the District Judge of the Federal Court in Cincinnati, dismissing the suit for infringement brought against the company, and of the recent decision, on appeal, of the Federal Court of Appeals of the Sixth District, the latter decision being rendered November 17, 1922. The suit was brought by the Fulton Company on the ground of infringement of W. M. Fulton's patent for a flexible wall. The full texts of both decisions are given in full.



B. & B. MULTIFLEX PNEUMATIC VALVE.

CORRECT HOME HEATING, featuring Trane vapor heat, is the title of an attractive circular, issued by the Trane Co., La Crosse, Wis., describing in general this method of heating and calling special attention to the fact that Trane vapor heat is over 25 years old.

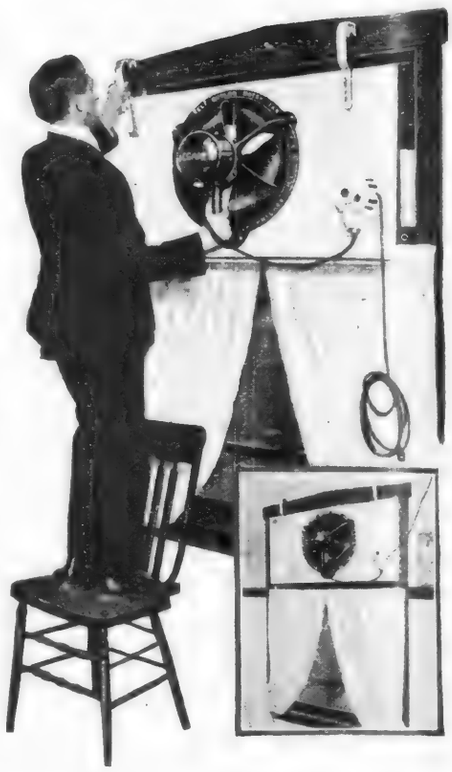
RELIANCE GAUGE COLUMN, No. 0, equipped with pressureless electric alarm, and described as the ideal small column for heating plants, is featured in circular matter issued by the Reliance Gauge Column Co., 5902 Carnegie Ave., Cleveland, O. For pressures under 15 lbs. the column is fitted with the electric alarm and, for higher pressures, either with whistle, with regular Reliance electric alarm, or both.



RELIANCE GAUGE COLUMN, EQUIPPED WITH LOW WATER ELECTRIC ALARM.

FARRFHERN ATMOSPHERIC STEAM HEATING is the name of a new system designed by J. E. Farrell, 210 Galley Avenue, Toronto, Ont., and described in newly-issued circulars. The only controlling features in large systems are the Farrfhern graduated radiator valve, control fittings and the Farrfhern condensator and air eliminator.

ILGAIR PORTABLE PANEL for use as a kitchen ventilator, is a unique appliance which has been developed by the Ilgair Electric Ventilating Co., Chicago, Ill., and is the subject of new circulars illustrating and describing this appliance. The feature of the outfit is the panel itself containing the fan. No screws or nails are required for its installation as it may be hung like a picture on the wall and a connection made with a nearby electric lamp. The panel hangs directly over the molding or casing. It is painted white enamel and the fan itself is standard Ilg green. The ventilator is 16 in. in diameter and has a capacity of 1500 cu. ft. of air per minute. A variable speed motor is furnished with three-speed regulator for alternating current, and 50% speed reduction in direct current. The panels are furnished in three sizes, the entire weight of each being about 55 lbs.



TYPICAL INSTALLATION OF ILGAIR PORTABLE PANEL.

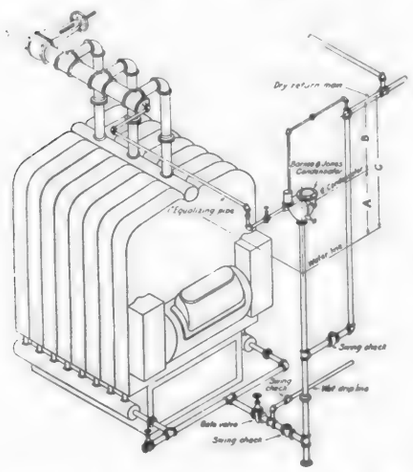
ARMCO INGOT IRON, as used in the construction of the dust-collecting apparatus at the plant of the Globe Wernicke Co., Cincinnati, O., is featured in a folder containing a view of this installation, together with a letter calling attention to the purity of this product. The particular installation mentioned was designed and erected by the Kirk and Blum Mfg. Co., Chicago.

MIDWEST STEEL SECTIONS are illustrated and described in an architects' and engineers' data book, published by the Midwest Steel & Supply Co., 28 West 44th Street, New York. While the book is devoted largely to overhead shafting layouts, there is an interesting section on the use of the company's products for fastening pining in tunnels, supporting heavy piping to columns or walls in buildings, suspending heavy piping from the beams or girders of ceilings, and suspending a large number of lighter pipes from the ceiling, as in refrigerator plants. Size 8½ x 11 in. Pp. 56.

CRANE BUSINESS SURVEY is the title of a new publication issued by Crane Co., Chicago, Ill., as a supplement to *The Valve World*. The publication is devoted to a report of business conditions. The first issue, dated December 27, 1922, reports business in the eastern zone as good outside of New York City and fair in the city. The south generally, it states, is in satisfactory shape. In the northern zone, general business is fair and collections rather slow. The cen-

tral zone is described as being in excellent condition as a whole. In the western zone, the volume of business is satisfactory, with collections quite good. In Canada, referring especially to Montreal and Toronto, general business is good and collections fair. The summary states that "there are a few bad spots and a few very good spots, but, taking the country as a whole, the reports indicate a general condition of reasonable prosperity." The survey is based on reports from Crane branch offices throughout the United States.

BARNES & JONES SYSTEM OF STEAM HEATING is presented in a new catalogue issued by Barnes & Jones, Boston, Mass., featuring the modulation valves, return valves and condensator comprising this system. In addition to typical connections of the various appliances the catalogue shows methods of hooking up the radiators, drips, etc. After reviewing the requirements of a successful modulation system, the Barnes and Jones system is offered as one that will meet these requirements, being the result of over 25 years' experience in designing and marketing apparatus of this kind. Separate sections of the catalogue are devoted to the modulation valve, the return valve and the condensator, with special data regarding each, including capacities and



BARNES & JONES CONDENSATOR CONNECTIONS.

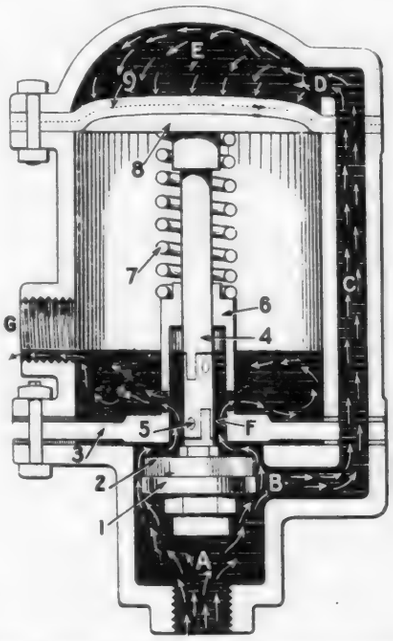
dimensions. Special attention is devoted to the condensator which is designed to insure the positive return of the water of condensation to the boiler.

It is explained that in any system where the return side is vented to the atmosphere and the condensation is returned to the boiler by gravity, the amount of pressure that can safely be carried on the boiler is limited to a few ounces, because any pressure in excess of this amount forces the water out of the boiler and up the return piping until a sufficient head has been attained to counterbalance the boiler pressure. Under these conditions the boiler would be burned out and ruined.

The Barnes and Jones condensator is designed to serve as a receiving tank to which all water of condensation is returned and in which the pressure is automatically equalized with that of the boiler. The condensator is installed near the boiler, as high above the water-line as possible. As pressure accumulates in the boiler the water of condensation flows into the condensator and, arising, causes the valve on the steam line between the boiler and the condensator to open, thus equalizing the pressures in the boiler and the condensator and allowing the water that has been collected in the condensator to return to the boiler by gravity. In this way, it is stated, the water of condensation will be automatically returned to the boiler, independent of the boiler pressure, whether it be a few ounces or several pounds. The typical connections shown in the catalogue will be found especially useful in making clear the application of the various devices. Size 7 x 9 in. pp. 10.

VALVE WORLD for January, 1923, the monthly periodical of Crane Co., Chicago, Ill., begins its nineteenth year, giving it a standing as one of the oldest house organs in the country. The January issue features "The Oil Industry in Montana," by E. P. Cole, while Ben C. Dailey presents "Reasons for a referendum on the Metric Question," *The Valve World,* as is well known, being an ardent champion of the movement for the adoption in this country of the metric system.

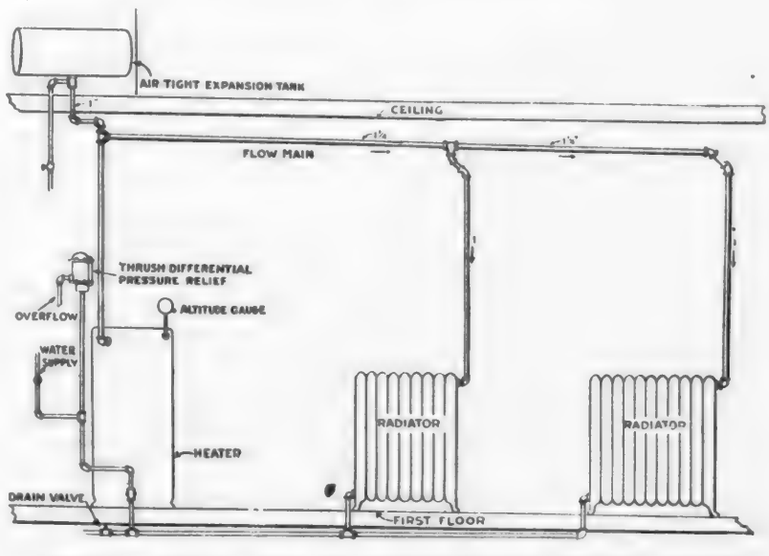
THRUSH HOT WATER HEATING SYSTEM (Tank-in-Basement method) is illustrated and described in a catalogue issued by H. A. Thrush & Co., Peru, Ind. In addition to the air-tight expansion tank used with this system, the equipment includes the Thrush automatic temperature damper regulator and the Thrush differential pressure valve. The damper regulator consists of a 3-in multiple disc thermostat which sets in an inner shell, surrounded by the hot water leaving the boiler. The water circulates in the regulator around the inner shell which contains the thermostats. By adjusting a weight on the lever it is possible to obtain the water temperature desired. The Thrush differential pressure relief valve, which is designed to relieve the excess pressure when it accumulates in a water heating system, is assembled so as to prevent dirt or sediment from accumulating around the seat as, of course, its tight closing is essential to prevent leakage of water when the pressure in the system has been reduced to the working pressure for which the pressure relief is adjusted. It is set to open at 12 lbs. above the static of a



OPERATION OF THRUSH DIFFERENTIAL PRESSURE RELIEF.

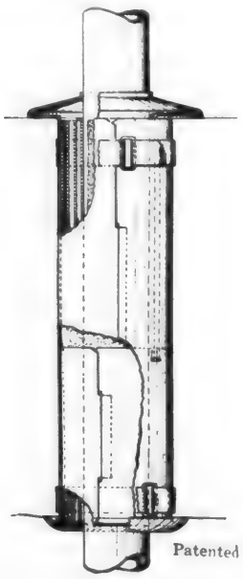
two-story building and is non-adjustable, to insure the operation of the pressure relief when the pressure has reached the maximum for which it is set.

The differential ratio between the disc and the diaphragm which operates it is 10 to 1. This serves to insure positive overflow of excess water in the heating system when needed. The catalogue includes instructions for the design and installation of the system, with detailed suggestions regarding each appliance. Size 5 x 6 in., pp. 16.



TYPICAL INSTALLATION OF THRUSH WATER HEATING SYSTEM.

FARLEY'S GRAB-ON FIRE-RESISTING SLEEVES, pipe hangers, pipe straps, roller hangers, wall radiator hangers, pipe anchors, hanger bar inserts and floor and ceiling plates, are presented in a catalogue issued by John W. Farley, 3748 East 71st St., Cleveland, O. Each type is illustrated and is accompanied by data regarding sizes and prices. Size 4 x 4 in. pp. 12.



"GRAB-ON" EXTENSION SLEEVE.

ERDMAN COMBUSTION SYSTEM, which comprises an unusual type of furnace grate, is covered briefly in a circular issued by the Erdman Forced Draft Burner Co., 96 Wall St., New York. The construction is intended to permit air to be admitted to the burners at the same pressure from a distributing chamber under the rear ends. As the burners are designed so that pressure will be the same throughout their length it is possible to maintain the air pressure the same under all parts of the grate surface. A steam-actuated regulator is used with these burners, designed to give a wide range of fan speeds for varying steam flow. This regulator is used to govern an engine and fan of any suitable standard make and it is easy to provide for a considerable overload if necessary.

DURALOY, described as a chrome-iron alloy and the result of twelve years of extensive research and experimentation, designed for use as a resistant to oxidation, corrosion and abrasion, is the subject of an engineering circular, published by the Cutler Steel Co., Pittsburgh, Pa. Developed primarily as a low-cost alloy to resist oxidation, this metal was found to possess not only this property but also that it acted as a satisfactory resistance, under certain conditions, to corrosion. Also its tensile strength at high temperatures and its hardness and toughness enabled it to offer great resistance to wear and abrasion. The manufacturer states that it is now possible to furnish the metal commercially in practically every form, including castings, rolled or forged bars, sheet, wire and tubing. The bulletin contains details of the physical properties of Duraloy, its composition and characteristics, its strength at high temperatures, its machining and welding qualities, and its resistance qualities to oxidation and heat. Duraloy is also described as practically non-warping, even at high temperatures. Other details refer to its corrosion and abrasive resistance. Among the recommended uses of Duraloy are for furnace parts, heat-treating equipment and many miscellaneous types of apparatus and equipment. Size 8½ x 11 in. Pp. 4.

STURTEVANT UNIT HEATER is the title of a new bulletin (No. 296), issued by the B. F. Sturtevant Co., Hyde Park, Boston, Mass., which shows not only the latest types of these appliances, but contains also an interesting history of their development from the original design of B. F. Sturtevant in 1870. Size 8 x 11 in. Pp. 16.

Cost of Living rose 1.8% during the summer, being that much higher in November, 1922, than in July, 1922, according to the latest comprehensive study of living costs of the country by the National Industrial Conference Board, New York. This change leaves the cost of living 58.4% higher than in July, 1914, but 22.5% lower than in July, 1920, when the cost of living in the United States reached its peak. Average rent of wage earners, houses increased 1%. The total increase in rents between July, 1914, and November, 1922, was 67%. On the latter date rents averaged 6% above their level at the peak of living costs in July, 1920, but within the year from November, 1921, to November, 1922, they decreased 1%.

THE ERDMAN BURNER.

New Publications.

INTERNATIONAL ANNUAL TABLES of constants and numerical data on physical, chemical and technological subjects, Volume 5, is now in the press and will be ready for distribution shortly. This work contains an annual summary of all numerical data published during the year in the fields of chemistry, physics, engineering, metallurgy and biology. Four volumes have thus far been published. The first three cover the years 1910, 1911 and 1912 and the fourth volume, in two parts, covers the years 1913, 1914, 1915 and 1916. Volume 5, which is now almost ready, covers the years 1917, 1918, 1919 and 1920. Subsequent volumes, it is stated, will again appear annually. The work is being carried on by a commission acting under the auspices of the International Union of Pure and Applied Chemistry. E. W. Washburn is the American member of the commission, with offices with the National Research Council, Washington, D. C. The American agent for the Annual Tables is Chicago University Press, Chicago, Ill., where a complete stock is kept of the volumes issued.

SAMPLING AND ANALYSIS OF COAL, COKE AND BY-PRODUDTS, detailing the methods followed by the chemists of the United States Steel Corporation, has been published by the Corporation's Chemists' Committee.

The work will be found of special value to any analytical chemist engaged in industrial work and will be of interest also to many others in various industries. It embodies the efforts during the greater part of a year of the corporation's fuel group of chemists. Bound in leather, 5 in. x 7¾ in. Pp. 200.

DOMESTIC ENGINEERING DIRECTORY for 1923 has made its appearance and reflects much credit on its publishers, Domestic Enginering Co., Chicago, Ill. Included in the catalogue section are some 350 pages of condensed catalogue data, representing the products of 228 manufacturers. Among the outstanding features of the book is a classified section of material used by the heating and plumbing trades, while another section is given over to the names and addresses of manufacturers of these materials. Size 7 x 10 in. Pp. 878. Price $5.00.

ANALYSES OF KENTUCKY COALS, containing the results of chemical analyses and heating-value determinations of several hundred Kentucky coals, are given in Technical Paper 308, just published by the U. S. Bureau of Mines. This is the second of a series of technical papers issued by the Bureau of Mines, dealing with the characteristics of the coals of the various states. Technical Paper 269, relating to Iowa coals, was published some months ago. Copies of Technical Paper 308 may be obtained, at 10 cents a copy, from the Superintendent of Documents, in Washington.

From a Painting by HUGH FERRIS
© ARCO 1923

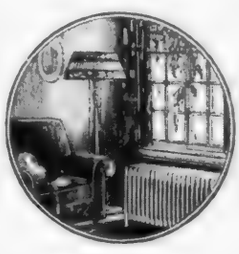
The Magnolia Building, the newest and largest office building in Dallas— ALFRED C. BOSSOM, *Architect*

"After most exhaustive investigation . . . Corto"

IT WAS "only after most exhaustive investigation," writes Alfred C. Bossom, "that Corto Radiators were used in the Magnolia Building." This investigation proved that "Corto Radiators are the most desirable type available, either here or in Europe."

The architect who makes an exhaustive investigation discovers the three factors of Corto superiority:

1. Corto is a thing of beauty—worthy of the famous French engineer from whom it takes its name.
2. Corto saves space. Ordinary radiators, to do the same work, must have 30% more bulk.
3. Corto saves fuel; its slender columns are so designed as to bring the maximum heating surface into contact with the air.



Good radiators are permanent; they last the life of the building. Surely it is wise to specify radiators that are graceful, compact and coal saving. Especially when the initial difference in cost is so very small.

We have a finely illustrated book about Corto Radiators. A postal card will bring you a copy. Address the office nearest your home.

AMERICAN RADIATOR COMPANY

IDEAL Boilers and AMERICAN Radiators for every heating need

104 W. 42nd Street, New York Dept. T-19 816 S. Michigan Avenue, Chicago

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

RADIATION COMPUTING CHARTS.

Heating - Steam - Floors

Radiation to compensate for Heat Losses through Floors. temp. dif. 30°.

Area in Sq. Ft.	Direct Steam Radiation				
	A-A_1-A_2	B-B_1	C	D	E
60	1	1	1	2	2
80	1	1	1	3	2
100	1	1	1	4	3
120	1	2	1	4	3
140	2	2	1	5	4
160	2	2	1	6	5
180	2	2	2	7	5
200	2	3	2	7	6
220	2	3	2	8	6
240	3	3	2	9	7
260	3	4	2	9	8
280	3	4	3	10	8

A- Double wood floor no plaster beneath
A_1 - Single do do with do do
A_2 - Cement or tile with wood floor on top
B - Single wood floor no plaster beneath
B_1 - do do do near earth
C - Double wood floor with plaster beneath
D - Cement or tile No wood floor
E - Dirt floor no wood whatever

RADIATION COMPUTING—Steam Heating, Floors. | No. 13-KK

Copies of this Data Sheet, printed separately, 5 cents each.

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

RADIATION COMPUTING

Heating - Hot Water - Floors

Radiation to compensate for Heat Losses through Floors temp. dif. 30°

Area in Sq. Ft.	Direct Hot Water Radiation				
	A-A1-A2	B-B1	C	D	E
60	1	1	1	4	3
80	1	2	1	5	4
100	2	2	1	6	5
120	2	2	2	8	6
140	2	3	2	9	6
160	3	3	2	10	7
180	3	4	3	12	8
200	3	4	3	13	9
220	3	4	3	14	10
240	4	5	3	15	11
260	4	5	4	17	12
280	4	6	4	18	13

A = Double wood floor no plaster beneath
A1 = Single do do with do do
A2 = Cement or tile with wood floor on top
B = Single Wood floor no plaster beneath
B1 = do do do near earth
C = Double wood floor with plaster beneath
D = Cement or tile No wood floor
E = Dirt floor no wood whatever

(This completes the Radiation Computing Tables).

RADIATION COMPUTING—Water Heating, Floors. No. 13-LL

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EFFICIENT HEATING
demands the JENNINGS PUMP

DUPLEX "D" UNIT
CONTINUOUS OPERATION

Hill Street Theater,
(Junior Orpheum Circuit)
Eighth and Hill Streets,
Los Angeles, Calif.

Capacity each pump 40,000 sq. ft. direct radiation, air capacity 25 cubic feet per minute in addition to a water capacity of 60 gallons per minute. The Motors are only 3 Horse Power.

THE Jennings Pump consists of two independent turbine units, an air pump and a water pump. As each material is handled separately, the boiler pressure is against the water only. The air and vapor approximately four-fifths of the volume handled, are delivered to atmosphere without back pressure. The saving in horse power is over fifty per cent. In other words, the cost of current to operate is cut in half.

Because of its compact design, this equipment can be installed in less than one-third the space necessary with other apparatus. All interior parts are bronze, supported on annular ball bearings mounted outside of casing. Moving parts revolve without contact.

Quiet, reliable operation without annoyance because of shut downs, and minimum of expense for repairs, is assured if the Jennings Hytor Vacuum Heating Pump is installed on your Vacuum Heating System.

There are many other reasons why the Jennings is being installed on practically all of the big jobs. Bulletin No. 15 gives them in detail. Write for it.

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TORONTO—Kent Building
WASHINGTON—710 14th Street, N. W.

The NASH ENGINEERING COMPANY
SOUTH NORWALK, CONN., U. S. A.

Trade and Miscellaneous Notes

Coming Events.

February 14, 1923.—Winter meeting of Eastern Supply Association, at the Hotel Astor, New York.

February 21-22, 1923—Winter meeting of the Central Supply Association at the Deake Hotel, Chicago, Ill.

April 18-19, 1923.—Annual meeting of the National Metal Trades Association, at the Hotel Astor, New York.

May 23-26, 1923.—Thirty-fourth annual convention of the Heating and Piping Contractors' National Association, in Chicago, Ill.

June 20-23, 1923.—Fourteenth annual meeting of the National District Heating Association at Cedar Point, O.

June 26-28, 1923.—Forty-first annual convention of the National Association of Master Plumbers, in Atlantic City, N. J.

Manufacturers' Notes.

Des Moines, Ia.—Governor Kendall of Iowa has come out in favor of a modern power and heating plant for the State House, in preference to the construction of a $5,000,000 Temple of Justice. The governor will urge upon the legislature the completion of the power plant, the boilers for which are now in storage. Also a tunnel has been constructed from the proposed site near the railroad track to the State House.

Kalamazoo, Mich.—A new central heating plant for the State Hospital and for a special hospital building to accommodate 100 infirm patients has been recommended by Dr. Herman Ostrander and is being considered by the State Administration Board. Its cost is estimated at $100,000.

Little Rock, Ark.—In the biennial report of the State Board of Control, one of the recommendations it for the remodeling and reconstruction of the entire central heating plant at the State Hospital.

Vancouver, Wash.—W. M. Streif, county clerk, in a letter to the Marysville (Wash.) Appeal, after calling attention to a report of the committee on Buildings and Grounds of the grand jury for 1922, to the effect that "The Hall of Records is modern and in first-class shape," declares: "With the exception of the antiquated plumbing system, the obsolete lighting system, the heatless heating system and the archaic ventilating system, in use in said building, I beg leave to state that I concur in the findings of said committee."

Colorado Springs, Colo.—Plans for the heating and laundry plant for the Beth-el Hospital, at Colorado Springs, call for an investment of between $25,000 and $30,000. The complete hospital, which is being built by popular subscription among the Methodists throughout the country, will cost $3,000,000.

Washington, D. C.—An idea of the enormous amount of government construction that may be expected within the next few years, is given in a letter from the Postmaster-General and the Secretary of the Treasury, to the Speaker of the House of Representatives. The letter transmits recommendations for a federal building program throughout the United States. The proposed construction detailed is confined to projects of the Postal Department in providing new or enlarged postoffice buildings. It takes no account of additional government construction by other departments. In addition, the itemized list leaves out of consideration most of the larger cities. Even thus limited the list represents construction to the amount of $37,467,000. Of this total Arkansas is to receive $1,050,000; Connecticut, $2,945,000; Illinois, $2,095,000; Indiana, $3,-

Some Subheadings Listed Under MECHANICAL DATA

Heating and Ventilating Data
Determining Drive and Discharge Arrangements
Pressure, Square Roots and Velocity Tables
Properties of Dry Air
Pressure Ins. Water to Overcome Friction Loss
Area and Circumference of Circles
Circular Equivalents of Rect. Ducts for Equal Friction

Being a Perpetual Catalog
Additional new pages to be published will be forwarded to the owners of these catalogs for insertion.

"Modern Ventilating Apparatus"

would have to be described in a perpetual catalog. The Autovent Fan and Blower Company products being modern, they have issued a perpetual catalog that is an encyclopedia of ventilating information. Every modern engineer should have it and can get it by sending his name and address to the

Autovent Fan & Blower Co.
730-736 W. Monroe St., Chicago, Ill.

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205,000; Massachusetts, $2,325,000; Michigan, $1,320,000; New Jersey, $1,150,000; New York, $4,415,000; North Carolina, $1,060,000; Ohio, $2,498,000; Virginia, $1,045,000; Pennsylvania, $3,029,000; and Wisconsin, $1,350,000. Other states will receive lesser amounts.

According to a survey made during the past year, a list of 140 buildings has been compiled, with the estimated cost of providing extension or new buildings. The recommendation is made that a program of construction be mapped out covering a period of years.

Winter Building, it is reported, has broken all records. In Chicago, for example, January 1 was marked by the breaking ground in the outlying districts for small homes and apartment buildings. A total of 115 permits was issued during the last week of December, representing construction to cost $6,470,150, as compared with $1,029,500 for the corresponding week last year.

Technology Bureau, 111 Nassau St., New York, calls attention to the fact that the scientific, technology and patent libraries of the New York Public Library and of the Engineering and Chemical societies are the most complete sources of this kind of information in the world. The Technology Bureau, it is added, offers its services for making searches in the American and foreign literature, reporting on the progress of certain industries, making abstracts from new literature and bibliographies, making translations of technical and scientific articles and securing technical and industrial information from foreign countries.

Detroit Builders' Exhibition, Inc., Detroit, Mich., is publishing 10,000 copies of a reference book in connection with Detroit's Fifth Annual Builders' Show, to be held shortly.

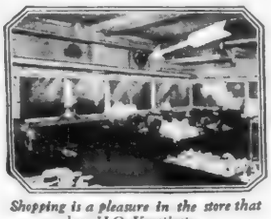
Building Operations for the year 1922 broke all records, according to the F. W. Dodge Company. December building contracts in the 27 northeastern states amounted to $215,213,000. Although this was less than the November figure, it was 8% greater than that of December, 1921. The December figure brought the year's total for these 27 states up to $3,345,950,000 which would indicate about 4½ billions for the entire country. This was an increase of 42% over 1921. Analysis of the year's record shows that residential building amounted to 40% of the year's total, public works

The Air You Breathe Should be As Pure as the Water You Drink

Wherever you live, shop, work or dine, attend church or theatre, you are wisely cautioned to look for good ventilation as you would for a fire escape

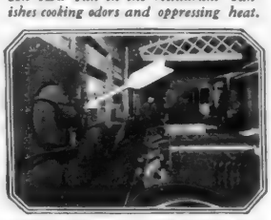
HIGH TRADE EFFICIENCY ILG MARK VENTILATING MACHINERY

In the office ILG Ventilation promotes health and efficiency.



Shopping is a pleasure in the store that has ILG Ventilation.

An ILG Fan in the restaurant banishes cooking odors and oppressing heat.



ILG Ventilation in public garages is a safety-first measure.

Self Cooled Motor Fans are safeguarding your health in thousands of stores, offices, halls, theatres, restaurants, etc., everywhere.

A sectional view of the *Ilg Self-Cooled Motor Propeller Fan,* illustrating the patented method of ventilating the motor by the vacuum created at the axis of the fan, drawing a current of air from the outside through the tube or vent pipe connecting with the hood which completely encloses the motor on all sides but the front. The vent pipe serves as an intake for the air, guides it to the heart of the motor where it is carried away with the general exhaust. This all-important feature is broadly protected by basic patents.

ILG Ventilation is a guardian of human welfare in public buildings.

Foul air does not contaminate food products where there is ILG Ventilation.

ILG Ventilation promotes good health sanitation and personal hygiene.

Industrial plants recognize ILG Ventilation as the life force of man-power.

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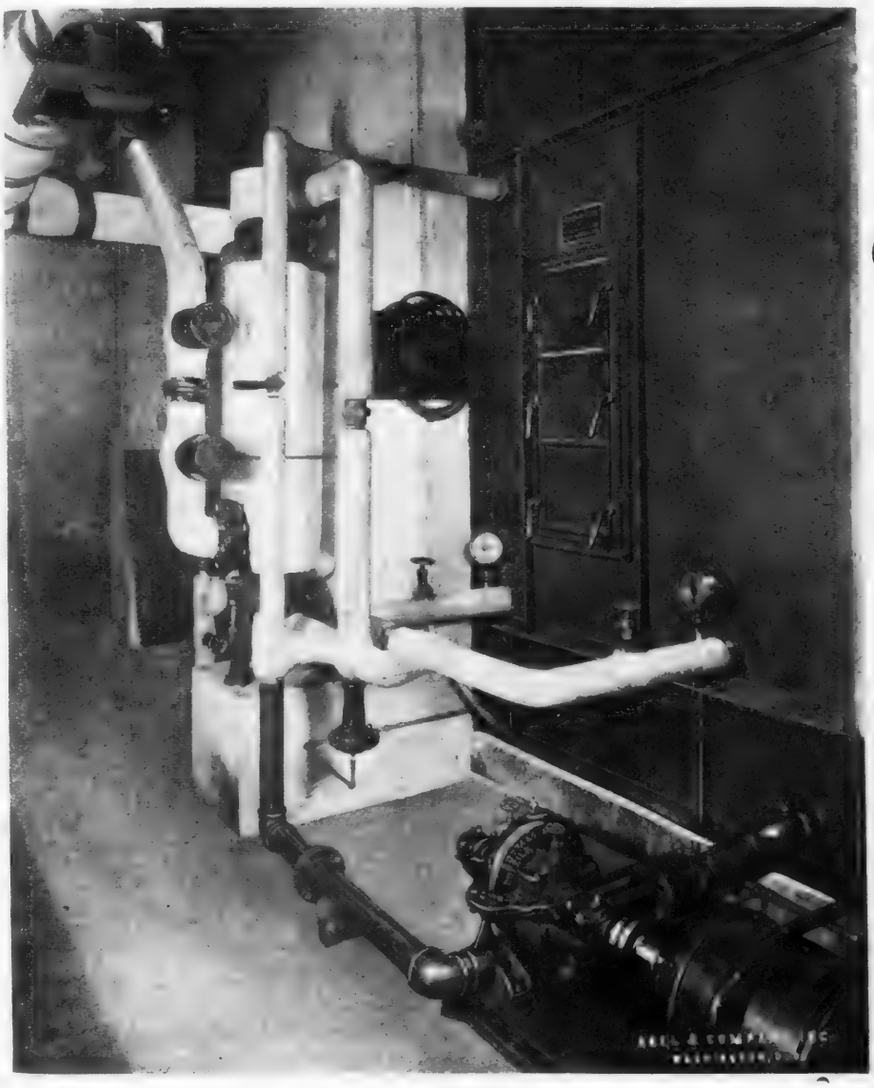

U.S.A. Safeguards its Priceless treasures with Carrier Air Washers

ORIGINAL historical relics in Freer Museum of the Smithsonian Institute, which portray the history of the world—are protected from destruction by dust accumulation, and comfort of visitors or employees is put under absolute control, by means of conditioned Air.

Protect the human treasures in school or assembly places with

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Carrier Air Washers—are simple and foolproof, require no priming of pump, have non-clogging nozzles which require no high pressure, use screens with ample surface, are easy of access and quickly cleaned in a few minutes.

Tell us your problem and get the whole story from our engineers without obligation. Address Dept. #36.

Carrier Air Conditioning Company of America,

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and utilities to 17%, business buildings, 15%; industrial buildings, 10% and educational buildings, 9%. The forecast for 1923 is that there is likely to be an increased demand for business and industrial buildings, and a comparative restriction of the residential construction program. The middle West, it is stated, seems more likely to equal last year's record than the eastern sections.

In New England, December building contracts amounted to $20,880,000, a decrease of 22% from the previous month and of 21% from the corresponding month of last year. In New York State and northern New Jersey, the figures, $56,263,000, were 22% under the preceding month and 10% under December, 1921. In the Middle Atlantic States, contracts totalled $37,636,000, 14% over November and the same increase over December, 1921. The Pittsburgh district, with figures of $29,651,000, showed a decrease of 29% from November and an increase of 33% over December, 1921. The Central West returned figures of $66,462,000, practically the same as November, but 45% in excess of the corresponding month last year. In the Northwest the figures of $4,320,000 were 9% above those for November, but 49% below those for December, 1921.

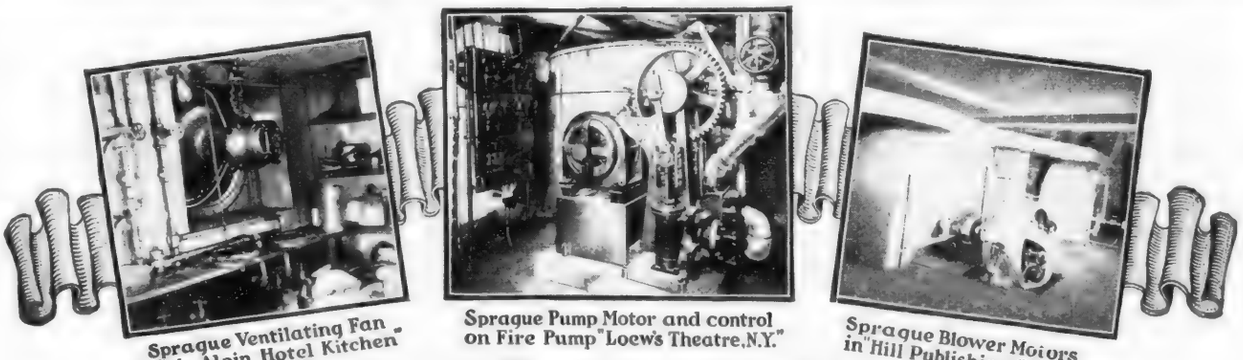
New York.—The largest building program ever contemplated by any board of education in the world has been proposed in a report laid before the New York City Board of Education by Henry Barrett Crosby, an architect, whose appointment to reorganize the Bureau of Construction and Maintenance has been provided for by resolution of the board. The report recommends the construction of over 200 school buildings, at a cost of more than $100,000,000. The personnel of drafting engineering and other departments, says the report, will have to be increased. Even then much work will be given to outside architects. Ordinarily only 25 new school buildings are required per year to keep up with the normal growth of population. The average cost of the proposed new buildings is about $500,0000. If Mr. Crosby's appointment is made permanent, he will assume practically all of the duties of the bureau superintendent, an office left vacant on the first of this year by the retirement of C. B. J. Snyder.

Wage Earnings rose 3.4% in three months, according to a nation-wide survey of wage changes covering 400,000 wage earners in 23 industries, just completed by the National Industrial Conference Board.

Cleveland Heating and Piping Contractors' Association elected the following officers at its recent annual meeting: President, M. L. Crowell, Crowell & Smith Co.; vice-president, A. L. Becker, Becker Heating and Ventilating Co.; secretary, W. B. Van Sickle, Price & Welker; treasurer, A. E. Welker, Price & Welker. Executive committee: the officers and Edward Maurer, Maurer Bros. Co.; F. M. Daugherty, Grinnell Co., Inc.; Walter Klie, Smith & Oby Co.; W. C. Clark, Becker-Seidel Co.; and Melvin Jones. Following the election, the association held a dinner dance at which Edward Maurer acted as toastmaster. He presented the retiring president, F. M. Daugherty, with a loving cup as a token of esteem from the association.

Chicago Heating and Piping Contractors' Association, at its annual meeting and banquet at the Sherman Hotel, December 7 elected the following officers: President, Charles Graves; vice-president, Matt Grage; treasurer, Al. Brunner; secretary, Louis A. Conrad.

New York State Fuel Administration announces that to meet the present emergency, special orders will be issued by the State Fuel Administrator. These orders shall be issued only upon satisfactory proof of lack of fuel, sickness or extreme need or suffering. They shall be known as emergency orders and when countersigned by a duly-accredited representative of the New York Fuel Adminstration, shall be honored by all distributors of fuel in the State of New York and shall have priority of delivery over all other orders. Under these orders delivery will consist of a minimum of two weeks' supply and a maximum of 30 days' supply. The order took effect January 8, 1923.



Sprague Ventilating Fan in "Mc Alpin Hotel Kitchen"

Sprague Pump Motor and control on Fire Pump "Loews Theatre, N.Y."

Sprague Blower Motors in "Hill Publishing Plant"

SPRAGUE EQUIPMENTS SATISFY

It Pays to Put in Equipment that Satisfies

Sprague Ventilating Fans, Pump Motors, and Blower Drives have stood the test of time. You will find them doggedly doing service, day and night, down in the vitals of many conspicuous buildings in our great cities.

They can be depended upon. They are made *right* and are backed by one of the oldest manufacturers of electrical apparatus in the United States. Write our nearest Branch Office today.

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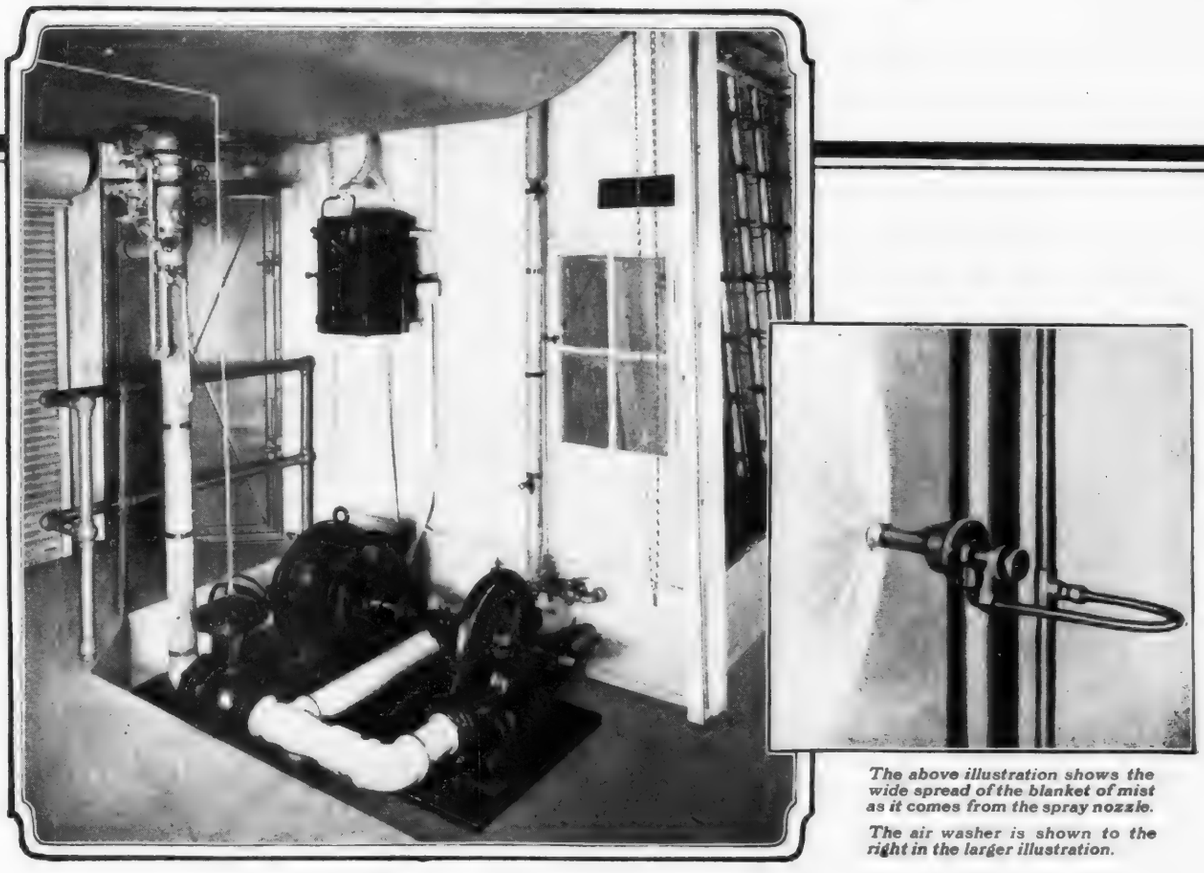

The above illustration shows the wide spread of the blanket of mist as it comes from the spray nozzle.

The air washer is shown to the right in the larger illustration.

Distinctive Service In Air Washers

Air that is properly humidified, cooled, and as clean and pure as a mechanical process can make possible, is a certainty with the American Blower Air Washer.

It's because of the special design of the spray nozzles of the American Blower Air Washer that the impurities are removed from the air passing through this air purifying system.

These spray nozzles produce a heavy blanket of mist so finely divided as to literally form a dense cloud through which every atom of air must pass, causing it to be cooled, humidified and purified.

The automatic flushing feature of these nozzles provides a means for keeping them clean and insures continuous operation at a maximum efficiency.

If you have a ventilating problem bring it to the attention of our engineers. Many years of practical experience enables them to cooperate with you.

AMERICAN BLOWER COMPANY, DETROIT
BRANCH OFFICES IN ALL PRINCIPAL CITIES
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(215)

American Blower

"Sirocco" TRADE MARK

EXHAUSTERS · VENTILATING FANS · AIR WASHERS · BLOWERS · ENGINES

FOR HEATING, VENTILATING, DRYING, AIR CONDITIONING, MECHANICAL DRAFT

Chicago.—A committee representing the heating and ventilating industry has been organized by Benjamin Nelson, president of the Illinois Chapter, A. S. H. & V. E., to co-operate with the Chicago Real Estate Board in staging Chicago's Third Annual "Own Your Home" Exposition, at the Coliseum, March 24-31, 1923. Mr. Nelson will serve as chairman of this committee Other members are William H. Chenoweth, Warren Webster & Co.; William T. Dean, Combustion Co.; John M. Frank, Ilg. Electric Ventilating Co.; and Charles F. Newport, Newport Boiler Company. A sub-committee representing the oil-burning interests, has been organized with William T. Dean as chairman. The other members are: J. E. Clarisey, Lynch-Clarisey Co.; J. L. L. McCormack, Hardinge Bros., Inc.; R. M. Nelson, Automatic Burner Corporation; R. E. Norris, Chicago Nokol Co.; E. W. Sladkey, Winslow Boiler & Engineering Co.; and M. W. Woolsey, Continental Oil Burner Corporation.

Washington, D. C.—The press has recently carried reports of suits brought by the United States against a number of contractors who built the military cantonments in the summer of 1917. Such suits have already been begun against Thompson-Starrett Company, Camp Upton, Yaphank, New York; Hardaway Contracting Company, Camp Jackson, Columbia, South Carolina; A. Bentley and Son, Camp Sherman, Chillicothe, Ohio; Geo. A. Fuller Company, Camp Funston, Fort Riley, Kansas; James Stewart and Company, Camp Pike, Little Rock, Arkansas; Chas. Weitz Sons, Camp Dodge, Des Moines, Iowa; Erwin and Leighton, Camp Dix, Wrightstown, New Jersey; Porter Brothers, Camp Custer, Battle Creek, Michigan; Rinehart and Dennis, Camp Lee, Petersburg, Virginia; and Stone and Webster, Camp Travis, San Antonio, Texas.

The amounts sued for are not only enormous in themselves but represent substantially 50% of the total paid to the contractors. Thus, the suit at Camp Upton is for $6,000,000 out of a total of probably less than $12,000,000; at Camp Funston for $4,000,000, out of less than $8,000,000. Others are of like amount and proportion.

The form of complaint is summarized by William B. King, writing in the American Contractor, as follows:

(1) That the contractor falsely represented that it had experience in similar work and had a suitable organization.

(2) That it did not carry out in good faith the undertakings assumed.

(3) That it knowingly, illegally, recklessly, and fraudulently violated and abused the confidence and trust imposed by the contract.

(4) That it counselled, permitted, and connived in carrying on the work in a groosly negligent and inefficient manner.

(5) That it committed great and unconscionable waste of materials.

(6) That it caused illegal and unwarranted claims and vouchers for materials to be presented and paid.

(7) That it employed workmen so excessively as to retard the work by confusion.

(8) That skilled and unskilled workmen were mingled so that the morale and effectiveness of the whole force was destroyed.

(9) That there was no attempt to classify workmen, but that the unskilled were paid the same as skilled, greatly in excess of customary wages in the locality.

(10) That it permitted continual loafing and sabotage by workmen.

(11) That it procured excessive quantities of materials of all kinds.

(12) That it caused large quantities of cement, wallboard, tar paper, and other materials to be destroyed.

13) That it procured payments for truck and team hire in excess of the needs and of the schedule rates.

(14) That it procured payment of claims for overhead expenses not properly chargeable.

(15) That it employed sub-contractors to do work which it should have done itself.

(16) That it conducted commissary and hospital privileges in a reckless and wasteful manner.

(17) That it received payment for

Cycloidal
MULTIVANE FANS
TRADE MARK

Heating and
Ventilating
Apparatus
Fans and
Blowers

Garden City Fan Co.
Manufacturers since 1879
McCormick Bldg.
CHICAGO

Eastern Office
Cochran & Wrightson
47 W. 34th Street
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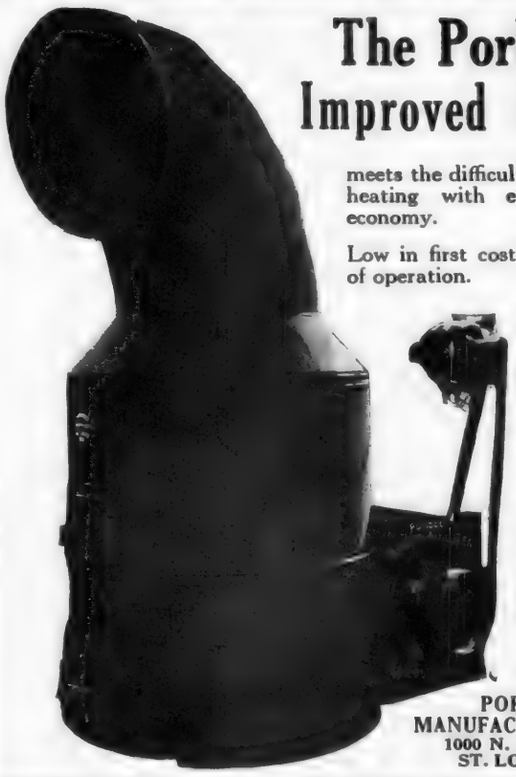
The Porbeck Improved Heater

meets the difficulties of garage heating with efficiency and economy.

Low in first cost and low cost of operation.



Burns coal, coke, oil and wood. No need of ducts or distributing pipes.

Adapted for any size building.

Send for descriptive matter.

PORBECK MANUFACTURING CO.
1000 N. Market St.
ST. LOUIS, MO.

Peerless Ventilator

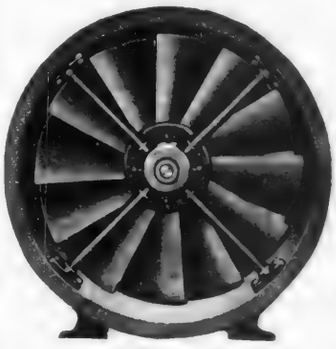
BUILT RIGHT RUN RIGHT

The New York Blower Co.

Chicago, Ill. **La Porte, Ind.**

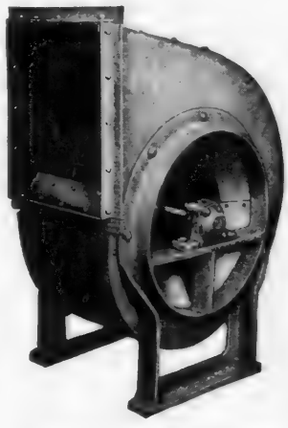
Peerless Air Washer

We manufacture a complete line of fan equipment and appurtenances. By concentrating on this one class of products we are able to make them better every year.



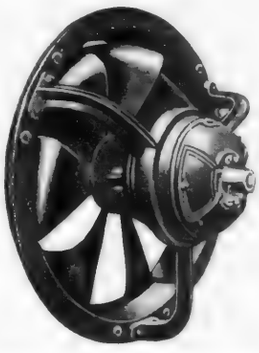
Pulley Driven Disc Fan for Mines

The old fallacy that fan equipment was a luxury is now known to be untrue; it is an economical necessity. We can give actual installations in all kinds of industries where through the wise employment of fan equipment manufacturers have improved the quality of their product, and increased production with a reduction in factory cost.



Type "C" Seri-Vane Fan

If you are interested in drying, humidifying, heating, ventilating, mechanical draft, removal of shavings or similar installations, please communicate with us. If we cannot honestly prove facts to you showing the benefits that will follow from an installation for your special problem, we will frankly so state.



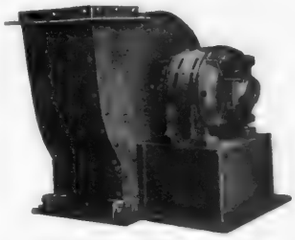
Motor Driven Propeller Fan

Slow Speed Planing Mill Exhauster

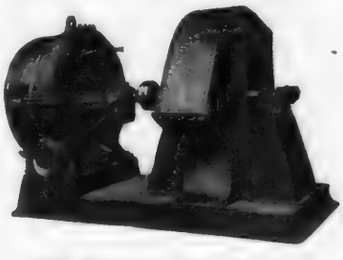
The New York Blower Co.

Chicago, Ill. **La Porte, Ind.**

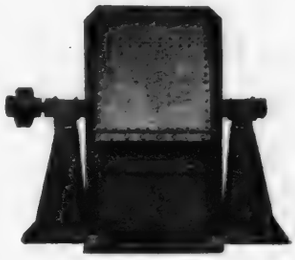
Branch Offices in Principal Cities



High Speed Type "C" Seri-Vane Fan



High Pressure Blower Direct Connected to Turbine



Stoker Fan

supervisory employes at exorbitant rates and for time in excess of that during which they were engaged.

(18) That it wrongfully failed to use any effort to keep workmen employed with regularity or intensity, and thus exorbitant sums were paid for labor.

Manufacturers' Notes.

Williamson Heater Co., Cincinnati, O., suffered a loss by fire recently of two of the four buildings comprising its main plant. The plant is located in Oakley, a suburb of Cincinnati. The loss is estimated at $100,000.

Laib Co., Louisville, Ky., manufacturers and distributors of heating and plumbing supplies, reports that representatives of many of the leading manufacturing concerns attended its recent annual sales banquet. Seventy of the company's representatives were present. P. B. Wallace, assistant treasurer, acted as toastmaster and addresses were made by President George H. Laib, Treasurer Philip F. Laib; A. W. Foos, V. J. Lawrence, B. B. Barnett, advertising manager; and by F. A. Rooney, vice-president of Hart & Crouse Co., Utica, N. Y. The Laib Company has recently filed articles of amendment to its charter, providing for an increase in capitalization from $150,000 to $900,000.

Crane Co., Chicago, Ill., is planning the erection of a $25,000 warehouse at South Bend, Ind., near the plant of the Singer Mfg. Co.,

York Heating & Ventilating Corporation, Philadelphia, Pa., will be located, after March 1, at 1502 Locust Street, Philadelphia. The change is due to the necessity for increased office space. The company's plant is located in Bridgeport, Pa. (just outside of the Philadelphia limits) but the sales offices have, for the past several years, been located in the Shubert Building, Philadelpha. The York Heating and Ventilating Corporation specializes in heating and ventilating engineering work, and in addition manufactures the York unit heater, equipped with the York jointless steam coil. The corporation also handles all classes of sheet metal construction in connection with heating and ventilating and manufactures the York patented nesting trays used for evaporating, cooling and drying purposes.

Hart & Cooley, New Britain, Conn., manufacturer of air registers, has increased its capital stock from $660,000 to $990,000.

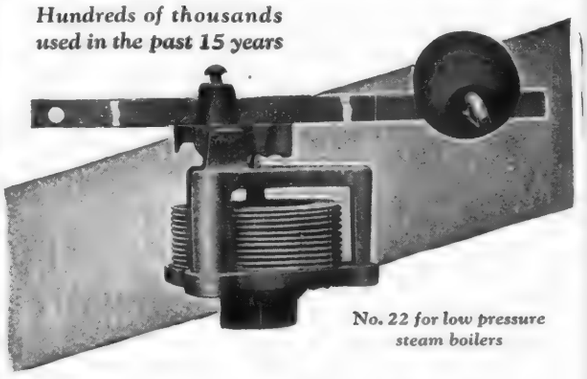
Chapman Valve Mfg. Co., Indian Orchard, Mass., has increased its capital stock from $1,000,000 to $1,500,000.

Ohio Injector Co., Wadsworth, O., will build a three-story addition to its plant at that place.

Johns-Manville, Inc., New York, has put through its plan for the recapitalization of the company. The number of shares of no par value will be increased from 25,000 to 250,000.

Crane Co., Chicago, Ill., has leased a building in Jersey City, N. J., on Fremont Street, which the company will open in the spring as a branch of its

Hundreds of thousands used in the past 15 years



No. 22 for low pressure steam boilers

Make Your Work Stand Up

When you install a steam or hot water boiler equip it with a Sylphon Regulator. Your client will get accurate, positive, sensitive and long life regulation. You will get a job that stands up—and makes for your reputation every year.

Sylphon

DAMPER REGULATORS

These regulators are not new. They have satisfactorily stood the test of over fifteen years' service, in hundreds of thousands of cases. We are the originators of the SYLPHON bellows—that seamless, solderless, flexible, all-metal expansion member which is the heart of every Sylphon product. Do not accept imitations or substitutes.

Send for folder giving details and prices

THE FULTON COMPANY
KNOXVILLE, TENNESSEE
New York Chicago Detroit
Representatives in all Principal Cities

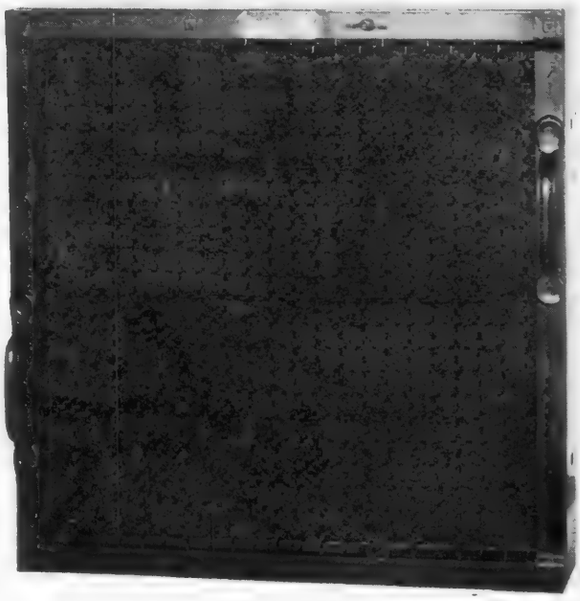
No. 45-A for water boilers and tank heaters

Our experience of 15 years is your greatest safeguard

The REED AIR FILTER

PATENTED MAY 16, 1922

The Outstanding Development in this Field



—An all metal Air Filter Operating with Inexpensive Chemicals

POSITIVE AIR CLEANING
WITHOUT WATER or MOVING PARTS

LOW RESISTANCE

HIGH EFFICIENCY

SIMPLE—PRACTICAL—EVERLASTING

SEND FOR REPORT OF RECENT AUTHORITATIVE TESTS→

William Reed Engineering Co.

INCORPORATED

601 W. 47th St.
NEW YORK

Factory and Engineering Dept.
LOUISVILLE, KY.

CHICAGO, 851 Marquette Bldg.
DETROIT, 909 Kresge Bldg.
PHILADELPHIA, 1711 Sansom St.
PITTSBURGH, 252 Frick Annex
BOSTON, 101 Tremont St.
BALTIMORE, 847 Equitable Bldg.
SAN FRANCISCO, 61 Fremont St.

Name
Company
Address

Newark office. J. F. Murphy is manager.

Belknap Mfg. Co., Bridgeport, Conn., has increased its capital stock to $400,000, and has purchased a $100,000 factory on Union Avenue which will be used to enlarge its capacity.

Jenkins Bros., New York, has engaged Lockwood, Greene & Co., as engineers for the enlargement of its plant in Bridgeport, Conn. The work will cost $250,000, and additional amounts will be expended for machinery and equipment for the manufacture of the Jenkins line of valves and other specialties.

American Radiator Co., Buffalo, N. Y., has let the contract for its new plant in St. Paul, Minn., to H. C. Struchen, of that city. The work will amount to $500,000. The project is described as the largest piece of winter building started in St. Paul for several years. The plant will be located between Prior and Fairview Avenues, on Minnehaha Street, and will be 1000 ft. long and from 60 to 200 ft. wide. Half of the building will be two stories high and the other half one story. The contract calls for the completion of the building by July 1.

Johns-Manville, Inc., New York, has appointed Ludlow & Peabody as the architects for its new 18-story building to be built at Madison Avenue and 51st Street, New York. The selection was made by lot from 23 architectural firms.

H. Mueller Mfg. Co., Decatur, Ill., is building a new recreation building in Decatur, for the benefit of its employees. The structure will be two stories high, and will occupy a space 60 x 90 ft., with a balcony running along one side, having a capacity of 250. A gymnasium, two bowling alleys, basket ball courts, etc., as well as a large dining room, will be housed in the building.

United States Radiator Corporation, Detroit, N. Y., has appointed Albert A. Ahlff as manager of its Buffalo branch to succeed C. W. Farrar, who has been made vice-president of the Excelso Specialty Works, of that city.

Wayne Heater Corporation, Richmond, Ind., manufacturer of the Wayne cross-draft boiler, has taken larger quarters at 217 Main Street, in the Colonial Building.

Stickle Steam Specialties Co., Indianapolis, Ind., is the changed name of the open Coil Heater & Purifier Company. The personnel of the company remains the same, Cole Stickle being president.

Continental Heater Corporation, Dunkirk, N. Y., has opened a sales office in Cleveland, with C. W. Lunger in charge.

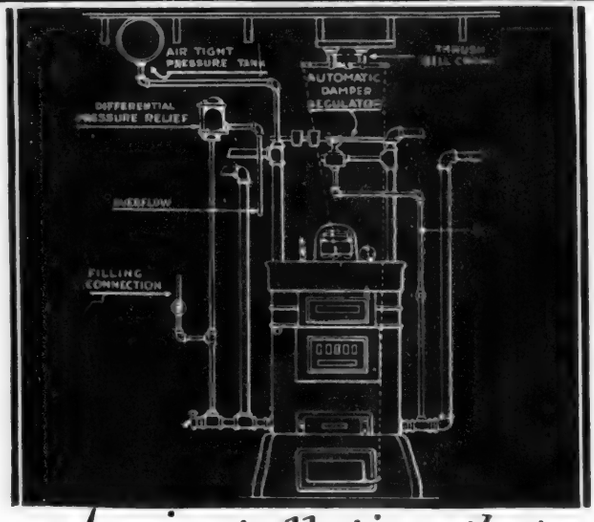
Hart & Crouse Co., Utica, N. Y., announces that William E. Taylor has been appointed manager of the company's New York branch, at 1103-4 National Association Building, 21 West 43rd Street. The company's Cleveland office has been recently removed to the Plymouth Building, 2022 East 22nd Street, Cleveland. The company also announces that Mr. Snell, formerly with the Mouat-Squires Company, has become associated with the Hart & Crouse Company as sales engineer and will be located in the Detroit branch of the company's western sales office, 315 East Adams Avenue, under the direction of J. L. Filler, western sales manager.

L. F. Ostrander, vice-president and sales engineer of the O-E Specialty Manufacturing Co., Milwaukee, Wis., met with an accident on the evening of January 18 when he fell from his automobile to the garage floor, fracturing two bones in his left arm. Mr. Ostrander is rapidly convalescing, however, and planned to make a trip through New England early in February.

Central Station Heating Notes.

Snohomish, Wash.—The new Servis Steam Heating Company's plant has been placed in operation, the pipes running as far as Avenue B and following the track of the Milwaukee railroad. The system will be extended the length of First Street and to the residence districts, as soon as the piping can be laid and patronage warrants the extension.

Astoria, Ore.—A proposed ordinance has been presented to the city commission providing for the granting of a 50-year franchise for the establishment of a central heating plant in Astoria, to a Portland group of financiers com-



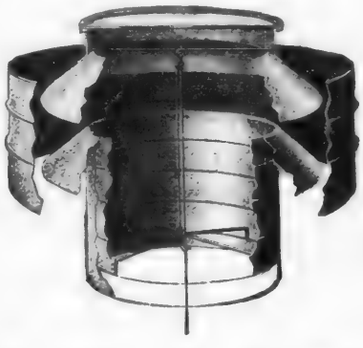
An installation that makes any Hot Water Heating Plant 100% better-

You can make a lifelong friend of any home-owner by installing the *Thrush Self-Regulating Hot Water Heating System* on old or new heating plants. Low cost and easy installation. Write for Catalog and more information.

H. A. Thrush & Co.

PERU INDIANA

B U R T



The Burt Glass Top Ventilator is

IDEAL

Has sliding sleeve damper by which temperature of the building can be easily and exactly regulated.
This sliding sleeve damper, once adjusted, is held permanently in any position by a special attachment that does away with fastening the cord to a nail, hook or post. Due to its not having a flat service, the damper will not collect dust and refuse.

Economical

Impure and hot air, smoke, steam or gas taken out of any building automatically and without any expense other than the first cost of the ventilators.

Made and Guaranteed by

THE BURT MANUFACTURING CO.

126 Main Street AKRON, OHIO

Heatovent
(REG · U · S · PAT · OFF ·)

YOU DO NOT THINK

of operating all of the electric lights in the school building from one switch, or all the radiators from one valve, then why should you have one fan system for ventilating all of the rooms in your school building?

THE MODERN WAY

is to install Buckeye Heatovents for ventilation, then you have a separate ventilating system for each room, operating only when the room is occupied.

The Buckeye Heatovent was developed primarily to effect the economical ventilation of certain buildings, wherein some of the rooms are not occupied all of the time. This condition is well illustrated in the Modern School Buildings, where the Laboratories, Libraries, Domestic Science and Manual Training Rooms are only occupied during certain periods of the day. The Gymnasium and Auditorium are used more after school hours than when classes are in session. In the industrial districts, evening classes keep a few of the rooms occupied long after the balance of the building is deserted.

Now when the building is ventilated by a central fan system, it is necessary to ventilate the entire building, even though the greater portion of same is not occupied.

Have you ever stopped to consider the fact that it costs more to ventilate the average school room, than it does to heat it?

In a well-ventilated building, one-half of your coal bill is for heating while the other half is for ventilation.

This ventilating cost, as well as operating expense, can be greatly reduced by using the Heatovent.

With the Heatovent, each room has its own individual ventilating system always ready for operation. When the room is occupied, push the button and noiseless fans deliver the correct amount of tempered fresh air into the room without any objectionable drafts. When the room is vacated, push the button and the fans cease to deliver the air, thus stopping this extravagant waste of fuel and electric power.

Old School Buildings in which no means of ventilation were ever provided can be fitted with the best of ventilation at a slight cost, by installing the Heatovent.

Our Service and Engineering Department stands ready to furnish plans and estimates for any building without obligation. Write us now.

BUCKEYE BLOWER CO.

TOWN AND LUCAS STREETS **COLUMBUS, OHIO**

Branch Sales and Engineering Offices:

BUCKEYE BLOWER CO.	BUCKEYE BLOWER CO.	BUCKEYE BLOWER CO.	BUCKEYE BLOWER CO.
324 Monadnock Bldg.	372 White Hall St.	503 Wabash Bldg.	1400 Broadway
CHICAGO, ILL.	ATLANTA, GA.	PITTSBURGH, PA.	NEW YORK, N. Y.

posed of John Gratke, Coe A. McKenna and Peter W. Walsh. The ordinance would grant a monoply in this field to the group and provides for the extension and maintenance of the plant.

San Francisco, Cal.—A petition filed by 52 customers of the Pacific Gas and Electric Company and the Great Western Power Company, with the State Railroad Commission, charges that both companies are charging excessive rates for steam heat. The complainants allege that the present rates were fixed when the price of fuel-oil ranged from $2 to $2.35 a barrel. The present price of fuel-oil in large quantities has dropped as low as 93 cents a barrel at the plant. The two companies supply steam heat in San Francisco and Oakland.

Ohio Power Co. has purchased the steam heating system formerly operated by the Ohio Electric Railway Company, in Lima, O.

University of Minnesota has issued a book entitled "Minnesota Public Utility Rates" which gives the rates paid for electric power, gas, water, and central heating service in all municipalities in the state. Twenty-nine communities are listed as having central heating plants. In the tabular matter data is given covering the population, number of consumers, heat sources, types of boilers, amounts of radiation and other information regarding the central heating industry.

New Incorporations.

Home Oil Heating Corporation, 735 West Jackson Boulevard, Chicago, capital $10,000. Incorporators: John E. Pfeffer, Howard F. Leopold, Alex. Bloch, Anton Klein and Harry W. Miller. The company will manufacture and deal in heating plants and apparatus. Correspondents, Adler & Lederer, 10 South La Salle St.

Consolidated Plumbing & Heating Supply Co., 701 Milwaukee Ave., Chicago, Ill., capital $5,000, to manufacture and deal in heating and plumbing supplies. Incorporators: John L. Sunde, John Roloff, Harold J. Rosenberg. Correspondent, Julius H. Miner, 109 North Dearborn St.

Harrison Spielman Co., 1400 East 67th Place, Chicago, Ill., capital $10,000, to manufacture and deal in heating, ventilating and refrigerating equipment and to engage in engineering work. Correspondent, H. A. Alexander, 212-230 West Washington St.

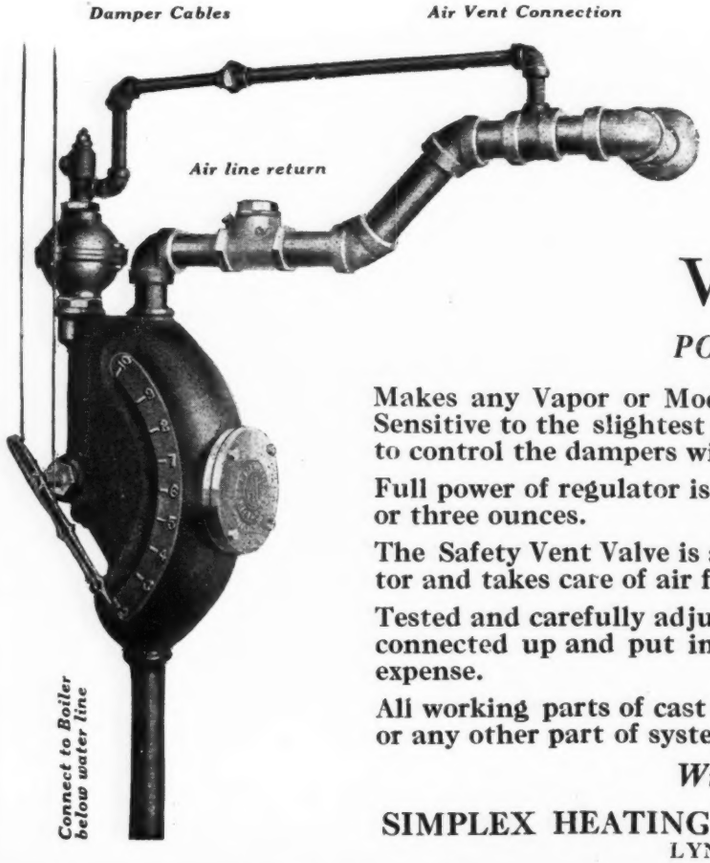
Swartout Co., Cleveland, O., capital $500,000, to take over all the lines of sheet metal and other products of the Ohio Body & Blower Company. D. K. Swartout recently resigned as president of the Ohio Body & Blower Company and will be at the head of the new company. The new company's products will include ventilators, steam specialties, exhaust heads, steam and oil separators, steam traps and feedwater heaters. In addition to President D. K. Swartout, the officers are: Vice-presidents, W. M. Pattison and D. K. Swartout, Jr.,; secretary and treasurer, W. E. Clement. In addition to its preferred stock there will be 50,000 shares of no par common stock. The company has taken quarters in the building formerly occupied by the Cleveland Milling Machine Co., on Euclid Avenue, Cleveland, and has also taken over the plant of the Ohio Body & Blower Company in Orville, O.

American Steam Specialty Co., Boston, Mass., capital $78,000, to deal in steam specialties. President, Joseph E. Swendeman; treasurer, John J. Hefferman.

Tate, Fisher & Rice Co., Boston, Mass., capital $5000. to deal in pipe, valves, fittings, etc. President, Charles B. Tate; vice-president, Charles E. Rice; treasurer, Frank S. Fisher.

Economy Light, Heat & Power Co., Boston, Mass., capital $100,000, to manufacture steam and electric generators and heating apparatus. Incorporators: Emile L. Galipeau, Harold E. Fregeau, Francis S. O'Neill, William R. Landers, William J. Meagher and Francis P. McCarthy, all of Milton, Mass.

Plouff Corporation, Boston, Mass. capital $116,665, to manufacture heating and ventilating apparatus and machinery. Incorporators: William E. Dixon, Somerville, Mass.; Frederick H. Plouff, Newton, Mass.; and Austin N. Barber, Braintree, Mass.



Wiley

Safety-Vent Vapor Regulator

POWER IS ITS MIDDLE NAME

Makes any Vapor or Modulating system safe and satisfactory. Sensitive to the slightest change in pressure. Has ample power to control the dampers with a good working margin.

Full power of regulator is exerted within a pressure range of two or three ounces.

The Safety Vent Valve is a distinguishing feature of this regulator and takes care of air from entire heating system.

Tested and carefully adjusted before leaving factory, ready to be connected up and put into service, with the least trouble and expense.

All working parts of cast bronze. Will last as long as the boiler, or any other part of system.

Write for details

SIMPLEX HEATING SPECIALTY COMPANY, Inc.
LYNCHBURG, VA.

A FEW AUDITORIUMS

In which the KNOWLES MUSHROOM VENTILATORS are installed

THEATRES

Little, New York.
State, New York.
Capitol, New York.
Rivoli, New York.
Carroll, New York.
New Amsterdam, New York.
Times Square, New York.
Apollo, New York.
Children's, New York.
Henry Miller, New York.
Globe, New York.
Princess, New York.
Columbia, New York.
Lyceum, New York.
Merrimac Square, Boston.
Wilbur, Boston.
New Hope, Dallas.
Aldine, Philadelphia.
Ambassador, Philadelphia.
New Century, Philadelphia.
Howard, Atlanta, Ga.
Poli's, Bridgeport.
Princess, Montreal.
Penn, Uniontown.
Pitt, Pittsburgh.
Fox, Oakland, Cal.
LeRoy, Pawtucket.
Melba, Dallas.
New Majestic, Dallas.
Bijou, Barre, Vt.
Main St., Niles, O.
Honolulu, Hawaii.
Alhambra, Des Moines.
Orpheum, Minneapolis.
Proctors, Newark.
Proctors, Schenectady.
Loews, Newark.
Hanna Annex, Cleveland.
Victory, Columbus.
McVickers, Chicago.
Liberty, Yakima, Wash.
Strand, Brooklyn.
Academy of Music, Brooklyn.
New Montauk, Brooklyn.
Small, Brooklyn.
Palace, Syracuse.
Albermarle, Brooklyn.
Grand, Rutland.
Orpheum, Sioux City.
Hippodrome, Youngstown.
Grand, Pittsburgh.
Strafford, Poughkeepsie.
Kirkendall, Emporia.
Colonial, Dayton.
Stillman, Cleveland.
Strand, Montgomery.
Palace, St. Paul.
Virginia, Norfolk.
St. Dennis, Montreal.
Schenly, Pittsburgh.
Majestic, Houston.
Sherman, Calgary.
Kenmore, Chicago.
Orpheum, Des Moines.
Park, Little Rock.
New Grand, St. Louis.
American, Salt Lake City.
Liberty, Salt Lake City.
Pantages, San Francisco.
Majestic, Jackson, Miss.
Royal, Alexander, Toronto.
Strand, Providence.
Picadilly, Rochester.

It is proof that Architects and Heating and Ventilating Engineers are convinced that the use of Mushrooms not up to the Knowles Standard of Efficiency is a hazard not warranted by the slight saving in cost.

It is not a mere coincidence that by far the great majority of Theatre and School Auditoriums in every State and in Canada are fitted with Knowles Air Diffusers.

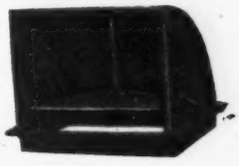
Notch Mushrooms

Patented

Adjustments are made by raising or lowering the hood and setting in ***recessed*** notches. In three outer bearings and is absolutely rigid. Made in 6 sizes, 4 inches to 10 inches in diameter and for either wood or concrete floor.

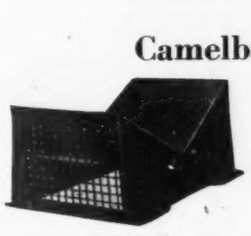
Aisle Hood Air Deflector

Used to throw the air out into the aisles in one direction. An inexpensive method of introducing a large volume of air without draft. A curved damper insures no friction loss. Two sizes—6x8x6" high and 4½x8x4½" high.



Patented

Camelback Air Diffuser



Patented

Two-way air delivery at ends. Less duct work required. Large area. Furnished with or without dampers. Size 14x7x6" high and 14x7x5" high.

Send for descriptive prints.

Blue prints and prices on request.

SCHOOL AUDITORIUMS

Chicago Public Schools.
New York City, Public Schools.
Bayonne Public Schools.
Los Angeles, Cal., Public Schools.
Wellesley College.
Yale College.
University of Illinois.
University of California.
Northwestern University.
Brookline High.
Des Moines Public Schools.
San Francisco Public Schools.
Portland, Ore., Public Schools.
Virginia, Minn., Public Schools.
Minneapolis Public Schools.
Sioux City, Ia., Public Schools.
Newark, N. J., Public Schools.
Indianapolis Public Schools.
Columbus, O., Public Schools.
Carnegie Institute, Pittsburgh.
Austin, Minn., High School.
Omaha, Neb., High School.
Colorado Springs, Colo.
Detroit, Mich., Schools.
Ironton, Ohio.
Bay City, Mich.

CHURCHES, ETC.

Aeolian Hall, New York.
Neighborhood Hall, New York.
Hall of Philosophy, New York.
League of Political Education, New York.
Clinton Ave. Congregational Education, New York.
Beth El, Detroit.
Cathedral, Omaha.
2d Ave. Baths, New York.
Masonic Temple, Cleveland.
Memorial Hall, Lowell.
City Hall, Pueblo, Col.
Rajah Temple, Reading.
Eastman, Rochester, School of Music.
Masonic Temple, Sioux City, Ia.
Synagogue, Newark.
Masonic Temple, Montreal
Salaam, Newark.
Westminster, Winnipeg.
Methodist, Calgary.
1st Church of Christ, New Orleans.
St. John's, Washington, D. C.
Sinai Temple, Chicago.

Knowles Mushroom Ventilator Company

**202 FRANKLIN STREET
NEW YORK CITY**

Wilbur Plumbing and Heating Co., 620 Seven Mile Road, Detroit, Mich., capital $5,000.

United Plumbing & Heating Supply Co., Milwaukee, Wisc., capital, $25,000. George J. Roska, president and treasurer; H. Roska, vice-president; Arnold Wangerin, secretary.

Keating Valve Co., Springfield, Mass., capital, $50,000, to manufacture and deal in valves and plumbing supplies. Incorporators: Henry L. Bowles, Charles Sumner Vining and Richard J. Talbot, all of Springfield.

Coppus Engineering Corp., Worcester, Mass., capital, $500,000, to deal in plumbing and heating supplies. Incorporators: Franz H. C. Coppus, Otto Wachsburg and Linwood M. Erskine, all of Worcester.

Elmgren Engineering Co., Hartford, Conn., capital, $50,000, to conduct a plumbing and heating business. Incorporators: Clarence J. Elmgren, Elmer G. Elmgren and Gustav V. Berglund.

Boiler Specialties Co., Clinton, Mass., capital, $100,000. Incorporators: Charles C. Sanderson, Adin W. Constance, Allan G. Buttrick, George E. O'Toole and Ora L. Stone, all of Clinton; John H. Coughlin, of Sterling, Mass., and Edward L. Hare, of Worcester.

William E. Bent, Inc., Springfield, Mass., capital, $25,000, to manufacture heating specialties. Incorporators: William E. Bent and B. A. Bent, both of Longmeadow, Mass., and J. Weley Shaw, Jr., of Springfield, Mass.

Contracts Awarded.

Sodemann Heat & Power Co., St. Louis, Mo., heating and ventilating new high school in St. Charles, Mo., for $23,487.

Bakersfield, Cal.—Bids were received as follows for the heating and ventilating of the new Kern General Hospital in Bakersfield: Bakersfield Sheet Metal Works, $35,852; Frank Davidson, Los Angeles, $29,440; L. Z. Brown, Los Angeles, $35,955; Burnham Plumbing Co., San Francisco, $63,976, including plumbing; and B. A. Newman Co., Fresno, $34,955. Bidders on the plumbing contract were: Bakersfield Plumbing Co., $34,806; Dailey Plumbing Co., Bakersfield, $38,885; William J. Carlison, Bakersfield, 39,116.

Thomas Heating Co., Racine, Wis., heating and ventilating new Kenosha County Court House in Kenosha for $58,717. The low bidder on the plumbing contract was Kissell Bros., Hartford, with a bid of $45,622.

WANTED

Advertisements under this heading, $2.00 per inch, payable in advance. A 1-in. advertisement contains 35 words. To secure insertion copy must be received not later than the 20th of the month preceding date of issue.

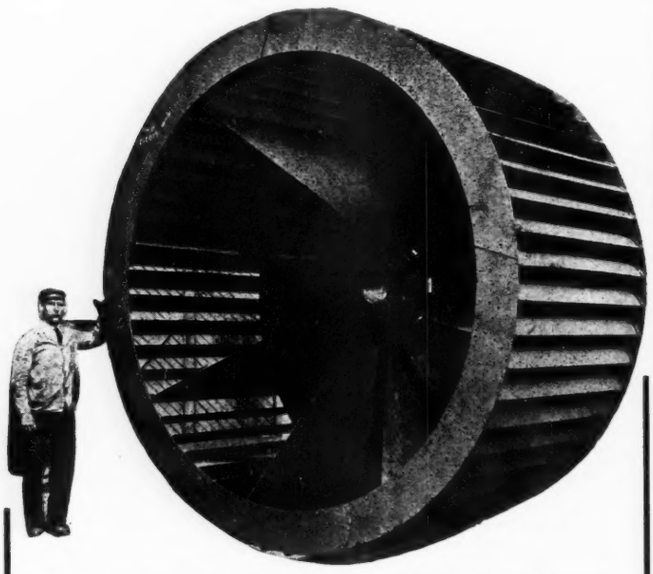
POSITION WANTED.—Heating and ventilating engineer, now employed, desires position with fan manufacturer or consulting engineer. 14 years' practical experience in all branches of heating and ventilating and fan engineering. Address Box 36 care of Heating and Ventilating Magazine.

WANTED.—Small consulting engineers' office in New York City wants young man with some experience in designing heating and ventilating. Opportunity to become head of drafting room. State age, experience and salary expected. Box 18, care of Heating and Ventilating Magazine.

SALESMAN WANTED.—Experienced men now selling steam heating and plumbing supplies, to call on steam fitters and heating trade New England States (separately), New York, Pennsylvania, Ohio and Delaware. Commission good. Permanent connection with large manufacturer of allied line. Territory allotted. Address P. O. Box 819, City Hall Station, New York

Wanted.—By a large boiler and radiator manufacturer, salesman to cover southwestern Pennsylvania. Forty-mile radius from Uniontown. Not Pittsburgh or vicinity. Want experienced heating man. State age, references. Correspondence treated confidential. Address Box 37, care of Heating and Ventilating Magazine.

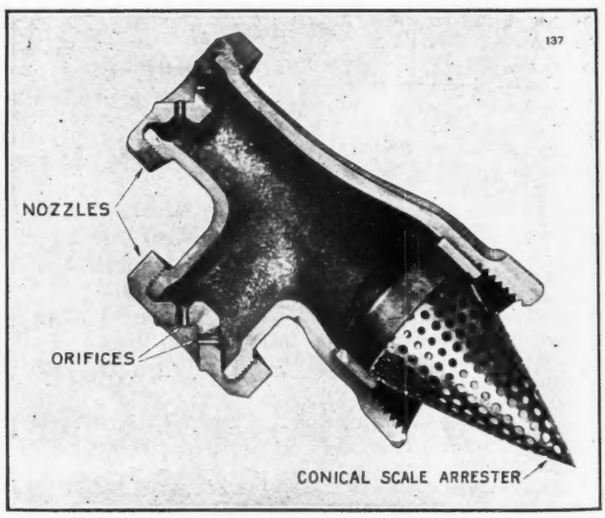
POSITION WANTED.—Mechanical engineer, energetic, capable, 12 years' broad experience in design and specification writing of mechanical equipment of all types of buildings, desires position where broad experience can be utilized. Technical graduate. A-1 references. Address Engineer, Box 10, care of Heating and Ventilating Magazine.



Special 11-foot Squirrel Cage Wheel

In sizes ranging from the tiniest to the very largest Massachusetts Squirrel Cage Fans are strongly guaranteed for performance and superior workmanship.

MASSACHUSETTS BLOWER CO.
WATERTOWN, MASS.
Branch Offices in Principal Cities



THE IMPACT AIR WASHER

The cut indicates a longitudinal section through a spray head, showing the two impact nozzles with their smooth, round orifices, entirely devoid of obstructing vanes or spiral passages. The conical scale arrester, with its numerous holes, each smaller than the nozzle orifice, intercepts and retains all dirt and scale large enough to plug the nozzles. During this slow accumulation the nozzles spray at full capacity.

Ask for Booklet K.

THE COOLING TOWER CO., Inc.
15 John Street, New York